Annual Rpt
FY 1986

AQUATIC AND WILDLIFE RESOURCES

JAN 13 1987
National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

DEPARTMENT OF AGRICULTURE

OCTOBER 1, 1985 - SEPTEMBER 30, 1986
FY 1986

Guam
Aquatic
and
Wildlife
Resources
Annual
Report
FY'86

ANNUAL REPORT
FISCAL YEAR 1986

GUAM
AQUATIC & WILDLIFE RESOURCES DIVISION
Harry T. Kami, Chief

DEPARTMENT OF AGRICULTURE
Elizabeth P. Torres, Director

Edited by:
Robert D. Anderson
Paul J. Conry

PERIOD COVERED:
October 1, 1985 to September 30, 1986

AQUATIC & WILDLIFE RESOURCES STAFF

The following persons were on the staff of the Aquatic and Wildlife Resources Division sometime during the reporting period (October 1, 1985 to September 30, 1986):

Harry T. Kami, Chief
Robert D. Anderson, Assistant Chief

Sport Fisheries

Michael E. Molina, Fishery Biologist IV
Gretchen R. Grimm, Fishery Biologist III
Robert F. Myers, Fishery Biologist III
Robert D. Rinehart, Fishery Biologist II
Gerald W. Davis, Fishery Biologist I
Oscar T. Mata, Biological Aide

Aquaculture

Wayne Kruckenberg, Fishery Biologist II
Robert J. Cruz, Biological Aide

Wildlife

Julie A. Savidge, Wildlife Biologist III
Gary J. Wiles, Wildlife Biologist III
Paul J. Conry, Wildlife Biologist III
Robert E. Beck, Jr. Wildlife Biologist III
Georganne Neubauer, Wildlife Biologist I (Part-Time)
Herman Q. Muna, Biological Aide
Donald S. Klotzback, Biological Aide
Jesse Guerrero, Biological Aide

Law Enforcement

Charles R. Bonds, Conservation Officer III
Johnny S. Villagomez, Conservation Officer II
Danny D. Wolford, Conservation Officer II
Wayne W. Bigler, Conservation Officer I
David C. Torres, Conservation Officer I
Herman R. Quichocho, Conservation Officer I
Johnny M. Taitague, Conservation Officer I

Clerical

Janet C. Blas, Word Processing Secretary II
June Elibosang, Administrative Assistant
Nancy C. Mafnas, Secretary Typist I
Annie S. Carriaga, Clerk Typist

ACKNOWLEDGEMENTS

The Aquatic & Wildlife Resources Division, Department of Agriculture, wishes to acknowledge the following persons and organizations for their assistance in our work:

The members of the Guam Fishing & Boating Association, the Marianas Fishing Derby Committee and the Manager of the Guam Fishermen's Coop for allowing fishery biologists to examine their fish.

All fishermen and fish weir operators who have cooperated with fishery data collection.

All farmers engaged in aquaculture who cooperated by providing information and harvest data.

All hunters who have cooperated with wildlife data collection by filling out and returning hunter questionnaires.

The Base Commanders of the U.S. Naval Magazine, Naval Facility, Naval Station, Naval Communications Station and the Andersen Air Force Base.

The Security Officers and their staffs at the U.S. Naval Magazine, Naval Station, Naval Communication Station, and Andersen Air Force Base.

The Commander of the Marianas Section, U.S. Coast Guard.

The members of both print and electronic media for their assistance with our conservation education program.

The Cushing Zoo for cooperating with the Division by caring for injured wildlife.

The personnel of the Naval Oceanographic Command Detachment, U.S. Naval Air Station, Guam, for providing weather data.

Table of Contents

			Page
Section 1	Coordination and Administration.		1
	Job C-1	Coordination of Guam's Fish and Wildlife Programs.	2
	Job C-2	Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources.	4
	Job C-3	Public Information and Education of Guam's Fish and Wildlife Restoration and Endangered Species Programs.	11
Section II	Guam Fisheries Investigations - Project FW-2R-23. (Federal Aid in Sport Fish Restoration Act)		12
	Job F-1-1	Offshore Fisheries Survey.	13
		Guam International Fishing Derby.	25
	Job F-1-2	Inshore Fisheries Survey.	30
		Fish Weir Report.	37
	Job F-1-3	Fisheries Data Processing.	40
	Job F-1-10	Studies of Recreationally Important Offshore Pelagic and Demersal Fish.	43
	Job F-1-11	Biomass and Stock Assessment.	44
Section III	Guam Fisheries Development - Project F-2-D (Federal Aid in Sport Fish Restoration Act)		46
	Job F-2-D-6	Construction of Fish Aggregating Devices.	47
	Job F-2-D-7	Development of Small Boat Launching Facilities.	50
	Job F-2-D-8	Development of Inshore Fishing Access Facilities.	51
Section IV	Aquaculture. (Public Law 88-309, Matching Funds)		52
	Development of Tropical Polyculture Fish Farming.		53
Section V	Guam Wildlife Investigation Project FW-2R-23. (Federal Aid in Wildlife Restoration Act)		57
	Job W-1-1-1	Determination of Current Population Size and Distribution of Guam deer.	58
	Job W-1-1-3	Determination of Diet Quality of Guam Deer: Final Report	66
	Job W-1-2-1	Preparation of a Status Report on Wild Pigs.	76
	Job W-1-2-2	Population Size and Distribution of Wild Pigs on Guam.	77
	Job W-1-2-4	Wild Pig Biology and Natural History.	82
	Job W-2-1-1	Preparation of a Status Report on Philippine Turtle Doves.	84
	Job W-2-1-2	Population Numbers & Distribution of Philippine Turtle Doves.	85

Job W-2-2-1	Preparation of a Status Report on Black Francolin.	91
Job W-2-2-2	Population Size and Distribution of Black Francolin on Guam.	92
Job W-4-1-3	Survey and Inventory of Native Land Birds on Guam.	100
Job W-5-1-2	The Current Status, Distribution and Natural History of Marianas Fruit Bats.	111

Section VI Guam Endangered Species Investigation Project E-1-1 122
Section 6 - Endangered Species Act of 1973

Job 1-2	Impact of *Boiga irregularis* and Other Predators on Native Bird Populations.	123
Job 1-6	Impact of Avian Disease on Guam's Native Bird Populations.	126
Job 4-1	Captive Breeding of Endangered Native Birds.	128

Section VII Guam Endangered Species Investigation, Project E-1-2 132
Section 6 - Endangered Species Act of 1973

Job 4-1	Captive Breeding of Endangered Native Birds.	133
Job 5-1	Status Survey and Natural History of Endangered Native Birds.	134
Job 6-1	Law Enforcement and Legal Protection for the Marianas Fruit Bat.	135
Job 6-2	Natural History, Biology, and Habitat Protection for the Marianas Fruit Bat.	136
Job 7-1	Biology of the Brown Tree Snake.	137
Job 7-2	Movements, Home Range and Activity Patterns of Brown Tree Snakes.	138
Job 7-3	Development and Testing of Control Methods for the Brown Tree Snake.	141

Section VII Law Enforcement 142

GUAM FISH AND WILDLIFE INVESTIGATIONS
PROJECT FW-2R-23
Federal Aid in Fish and Wildlife Restoration Acts

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: C-1
JOB NO.: 1

JOB TITLE: Coordination of Guam's Fish and Wildlife Programs.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

OBJECTIVES

To plan, coordinate, supervise, and administer all fish and wildlife restoration programs.

PROCEDURES

1. Supervise the planning and documentation of the Fish and Wildlife programs.
2. Administer all fiscal and budgetary matters and coordinate with the Central Accounting and Budget Office.
3. Administer all personnel matters including recruitment of off-island staff.
4. Represent the Division and Department of Agriculture in all matters pertaining to Fish and Wildlife Resources.

RESULTS

The Division Chief and his staff were involved in preparing required documentation for the DJ-PR funded Guam Fish and Wildlife Investigation Program (FW-2R) and the Guam Endangered Species Program (E-1) funded under a Section 6 Cooperative Agreement. Documentation included various Project Agreement and AFA amendments and the Project Agreement for Segment 24.

Fiscal and budgetary activities included monthly preparation and submission of reimbursement vouchers for our various Federal Aid programs and coordination with the Government Accounting and Budget Offices to ensure fiscal integrity.

The Division Chief and his staff represented the Division and the Department of Agriculture in all matters relating to fish and wildlife resources. This frequently entailed meetings with other agencies of the Government of Guam, various Federal agencies, and the military.

Division staff made a number of off-island trips related to Federal Aid programs. Wildlife Biologist Robert Beck escorted a shipment of Guam Rails and Micronesian Kingfishers to the Philadelphia Zoo in January, 1986, for later distribution to the various zoo's cooperating in the Division's captive breeding program. On this trip, Beck also visited the Bronx Zoo and the National Zoo's Conservation Research Center, and met with

representatives of the various participating zoos in Washington, D.C. He returned to Guam with a number of rails that had been bred at mainland zoos.

Wildlife Biologist Gary J. Wiles attended a biotelemetry workshop in Reno, Nevada. The workshop, which was sponsored by the Fish and Wildlife Service, provided training in telemetry techniques and data analysis that will be useful in implementing planned radio-telemetry studies of brown tree snake movements on Guam. Wiles also spent ten days on Rota, conducting surveys of Marianas fruit bats in conjunction with biologists from the Commonwealth of the Northern Mariana Islands (CNMI).

Assistant Chief Robert D. Anderson attended a snake control workshop on Saipan, at the request of the CNMI Division of Fish and Wildlife (DFW), where he made a presentation summarizing the snake problem on Guam.

The Division hosted a number of off-island visitors during the year. Ernie Kosaka, John Ford, Andy Yuen and Derral Herbst, all of the U.S. Fish and Wildlife Service, visited the office at various times.

Numerous representatives of the CNMI Department of Natural Resources, including Director Nick Guerrero, DFW Chief Arnold Palacios, and Biologists Thane Pratt, Tom Lemke, Phil Glass, Barbara Schmidt, and Phil Aldan, visited during the year to discuss subjects of mutual interest.

Ed Eckhoff, the National Marine Fisheries Service/U.S. Fish and Wildlife Service Special Agent on Guam, worked closely with the Division Chief and his throughout the year.

The Division experienced several staff changes during the year. Fishery Biologists Michael Molina and Gerry Davis, Biological Aid Terry Donaldson, and Conservation Officer Charles R. Bonds resigned during the year. Additions to the staff included Clerk-Typist Annie Carriaga and Biological Aid Oscar Mata.

Report prepared by Robert D. Anderson

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: C-2
JOB NO.: 1

PROJECT TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources.

JOB TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

BACKGROUND

The rapid development of Guam's economy has placed increasing demands upon Guam's natural resources. A trend toward urbanization has brought growth in the construction of residential, recreational, commercial, military, industrial, and public utility facilities, all of which have some impact upon the environment. To help minimize long-term adverse impacts of such development, the Division of Aquatic and Wildlife Resources (DAWR) has taken an increasingly active role in the area of technical guidance. Recently, the DAWR's responsibilities in this area have been increasing rapidly because review is now legally required for many development plans, permit applications, and impact statements.

OBJECTIVES

1. To minimize adverse impact resulting from the construction of recreational, commercial, residential, industrial or public utility facilities.

2. Provide technical assistance to military and civil agencies relative to the management and protection of fish and wildlife resources.

FINDINGS

The staff of the Division has been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications have been submitted to the Division for review. Field investigations and meetings with responsible agencies have been conducted in many cases as a part of the review process.

Various Division staff members actively serve as members of the following groups:

1. Cocos Lagoon Task Force
2. Region IX Regional Response Team - Oceania
3. Territorial Seashore Park Management Committee
4. Subdivision and Development Review Committee

Members of the Division have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Division staff maintain close liaison with the Department of Land Management, Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, U.S. Army Corps of Engineers (ACOE), the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the U.S. Navy, the U.S. Coast Guard, the U.S. Air Force regarding matters of environmental concern. In addition, staff members actively consulted with the numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Considerable public contact was maintained by Division staff during the reporting segment. In addition to occasional interviews on radio, television, and in newspaper, staff members participated in National Wildlife Week, Chamorro Week, Earth Week and Environmental Fair activities and gave talks to a number of civic groups, sportsmans clubs, and school and university classes.

Some specific Technical Assistance activities included:

1. The Division was represented on the Subdivision and Development Review Committee, which met bi-weekly to review applications for rezoning, variances, and various types of development. The Division's input at this level is very important in ensuring that the protection of Guam's fish and wildlife resources be considered in land use planning.

2. The Division provided technical assistance to Andersen Air Force Base regarding the problem of excluding deer from flightline areas and reducing populations to optimum levels. This assistance included providing advice, information, recommendations, for special either-sex control hunts.

3. The Division reviewed several proposed subdivision developments for potential impacts on endangered species. Because these projects were to be federally financed, the developers and the funding agency (Farmers Home Administration) were also referred to the U.S. Fish and Wildlife Service.

4. The Division responded to an inquiry regarding Diazonon-related wildlife mortality.

5. The Division reviewed plans and commented upon the Draft Environmental Impact Statement for the development of a deep-draft harbor in west Agana Bay and the associated redamation of 300 acres of reef-flat for commercial development.

6. The Division reviewed and commented upon an ACOE permit application to conduct maintenance dredging in the Agana Boat Basin.

7. The Division assisted in the preparation of several Agricultural Impact Statements which are required in cases involving the rezoning of lands zoned "A" (Agricultural). In cases where the proposed rezoning would have negative impacts on the conservation of wildlife resources recommendations were made to disapprove the proposed rezoning.

8. The Division reviewed and commented on several proposals to dispose of government land through sale or exchange and made appropriate recommendations for the conservation of wildlife resources.

9. The Division reviewed and commented on an amendment to the ACOE permit for the construction of a harbor of refuge for small boats to allow for an extension of channel dredging into Cabras Lagoon.

10. The Division reviewed and commented on the proposal of the Dai Ichi Hotel to construct a mooring system and walkway access to a dinner-cruise catamaran.

11. The Division provided technical assistance to the Air Force in assessing the damage caused by a fish and coral kill at CE Beach at Andersen Air Force Base.

12. The Division responded to many requests for information on laws and regulations pertaining to fish, wildlife, endangered species, hunting and fishing.

13. The Division responded to many requests for information on native wildlife, particularly endangered species.

14. The Division reviewed and commented upon Navy plans and Preliminary Environmental Assessments to construct facilities for the Maritime Prepositioning ships program and for the construction of a heliport and various wharf utilities for the Ammunition Wharf project.

15. The Division reviewed and commented upon the Merizo Tourism Draft Report for the Department of Commerce.

16. Division staff met periodically with supervisors of the Customs and Quarantine Division to discuss animal imports and endangered species questions.

17. The Division provided review and comments to the Department of Commerce regarding the Tumon Bay Master Plan.

16. The Division provided technical assistance to the U.S. Fish and Wildlife Service through the preparation and review of draft recovery plans for endangered fruit bats, native forest birds, the Vanikoro Swiftlet, and the Mariana Moorhen.

17. The Division reviewed and commented upon several ACOE applications to construct temporary boat access ramps in Cabras Lagoon.

18. The Division reviewed and commented upon the ACOE application for the construction of the Turtle Cove Mariana.

19. The Division answered numerous requests for information on hunting from both on and off-island individuals. Specific request included information on protective coloration, bow hunting, and laws and regulations.

20. The Division reviewed and commented upon the plans of the Guam Hilton Hotel for construction of a seawall in Tumon Bay.

21. The Division answered an inquiry regarding the feasibility of establishing a snake skin industry on Guam and provided sample skins.

22. The Division reviewed and commented upon the ACOE and SDRC applications for the construction of an underwater observatory in Piti Bay.

23. Division staff provided technical assistance to the Air Force on several occasions by identifying the remains of birds and bats involved in collisions with aircraft.

24. The Division reviewed and commented on the latest version of the Army Corps of Engineers Agana River Flood Control Plan and attended meetings to review the supplemental EIS.

25. Division staff reviewed and commented upon two environmental assessments prepared by the Navy for installation of fiber-optic cables at Naval Communications Area Master Station. Further contact was made with the Navy when the contractor cleared vegetation in excess of project specifications.

26. Division staff conducted site inspections and prepared comments to the ACOE on the illegal filling of an area in the Agana wetland by a landowner.

27. Division staff reviewed and commented upon draft management plans for the Navy's Ecological Reserves at Haputo and Orote Point.

28. Division staff reviewed and commented upon the environmental assessment for the clearing of vegetation near the flightline at Andersen Air Force Base.

29. Division staff provided technical assistance to numerous farmers and the Air Force and the Navy regarding pig damage. Damage control permits were issued when warrented.

30. The Division made recommendations to the Port Authority of Guam regarding potential utilization of their newly renovated harbor utility craft.

31. Several Division staff reviewed manuscripts for other authors and for professional journals.

32. The Division reviewed and commented upon the proposed dredging of a swimming area at the Jones Beach Resort.

33. Division staff provided technical assistance in developing a master permit system for aquaculture developments.

34. The Division reviewed and commented upon the plans of the Air Force to destroy some deactivated B-52 bombers with explosives and conducted endangered species surveys in the vicinity of the planes.

35. The Division reviewed and commented on the environmental impact assessment prepared by the Air Force for the proposed clearing of vegetation near the flightline at Andersen Air Force Base. The Division also provided information to the U.S. Fish and Wildlife Service for the Section 7 review of this project.

36. The Division provided technical assistance to the South Pacific Commission by reviewing annual work plans providing information on fishing activity, and reviewing a Tuna/Billfish assessment.

37. The Division staff completed several species accounts for the Endangered Species Information System.

38. Division staff participated in the Sea Grant Summer Fisheries Workshop, making several presentations to the enrollees.

39. The Division participated in the Bureau of Planning's Land Use Task Force and provided input to the Task Force on land-use laws and regulations that affect fish and wildlife resources.

40. The Division provided technical assistance to the Attorney General's Office in identifying fish killed illegally with explosives, hair and other tissues from suspected deer and pig carcasses, and in interpreting the laws and regulations that apply to fish and wildlife resources.

41. Division staff attended hunter safety briefings at Andersen Air Force Base to provide pertinent information to hunters.

42. Division staff made presentations on fish and wildlife resources at meetings of numerous clubs and other organizations during the year.

43. Division staff prepared numerous press releases to keep the public informed of fish and wildlife issues including hunting seasons, laws and regulations, endangered species, fish and wildlife importation, etc.

44. The Division provided information to the Port Authority of Guam regarding seasonal rabbitfish runs to support special conditions on the dredging of the Harbor of Refuge.

45. The Division provided information to the Department of Commerce on fisheries harvest and participation in the Merizo area.

46. The Division provided information to the South Pacific Commission regarding Guam's commercial and Subsistence Fishery.

47. The Division provided information regarding the harvest in the Agana area to Pacific Basin Environmental Consultants.

48. Technical assistance was provided to the Marianas Fishing Derby.

49. Technical information on the state of Guam's fish and wildlife resources was provided to the Guam Environmental Protection Agency for their annual report.

50. The Division reviewed and commented upon an ACOE permit application for the replacement of the Mobil Fuel pier at Cabras Island.

51. The Division reviewed and commented upon an illegal fill in the Talofofo River caused by an aquaculture development and a wetland permit application by the same developer.

52. Technical assistance and logistical support was given to Dr. Thomas Fritts of the U.S. Fish and Wildlife Service and Mr. Larry Shelton of the Philadelphia Zoo, each of whom spent time on Guam consulting with Division staff on the brown tree snake and native bird recovery projects, respectively.

53. The Division was involved in several meetings with the Department of Parks and Recreation, Commerce, Public Works, and the Port Authority of Guam to assess the public needs for boating access development. The Division reviewed and commented upon plans for boat ramps to be constructed in Umatac Bay, at the Harbor of Refuge, and Merizo.

54. The Division provided information to the Navy on the presence of the endangered Mariana Moorhen at Naval Station.

55. The Division worked closely with the Air Force and Fish and Wildlife Service in completing the revision of the Sikes Act Cooperative Agreement with Andersen Air Force Base.

56. The Division reviewed and commented on the proposed Andersen Air Force Base Hunting Regulations and worked closely with their staff in planning a special either-sex control hunt for deer.

57. The Division provided technical assistance and logistical support to Dr. Milton Heifitz, who came to Guam to field test a snake trap that he had designed.

58. The Division reviewed and commented upon a proposed commercial use of the old vehicle impound lot in Agana Swamp.

59. Division staff attended a Coastal Zone Management Conference sponsored by the Guam Bureau of Planning and made presentations on the role of brown tree snake predation in the decline of the native birds of Guam and on the import trade in fruit bats in the Pacific region.

60. Division staff met with a Coastal Zone Management Program evaluation team to review aspects of the Guam Coastal Management Program and to provide input regarding program improvement needs.

61. Division staff helped to organize and coordinate a brown tree snake workshop hosted by Andersen air Force Base and attended by representatives of local and federal agencies. The purpose of the workshop was to apprise responsible agencies of the economic and ecological impacts of the snake on

Guam, the threat to other island groups within the Pacific region, and to identify research needs and establish priorities for future work.

62. The Division was represented at a snake control workshop on Saipan, sponsored by the CNMI Division of Fish and Wildlife. A presentation on the impacts of the snake on Guam was made.

63. Division staff worked with administration of Naval Magazine in revising the Sikes Act Cooperative Agreement that the Division has with that base. Relevant information was provided to Naval Communication Area Master Station and to Naval Facility for their use in developing similar Cooperative Agreements.

64. The Division commented upon a U.S. Fish and Wildlife Service proposal to remove the Tinian Monarch from the Endangered Species List.

65. The Division provided information on sea turtle populations to the National Marine Fisheries Service.

66. Division responded to questionnaire surveys on predator/scavenger interactions, a National Survey of State Fish and Wildlife Agency Revenue, freshwater recreational fishing facilities, fish and wildlife violations and penalties, hunter education programs, sport fishing clubs and organizations, boating access, and regulations requiring the use of "Hunter Orange".

67. The Division provided technical assistance to the Guam Environmental Protection Agency and Army Corps of Engineers in assessing damage to Dogleg Reef in Apra Harbor caused by the improper temporary storage of caissons by the Navy's ammunition wharf contractor.

68. Division staff conducted site inspections and prepared comments to the Navy and other concerned agencies regarding illegal construction and fill activity in a wetland area at Naval Station.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: C-3
JOB NO.: 1

SUB-PROJECT TITLE: Public Information and Education of Guam's Fish and Wildlife Restoration and Endangered Species Programs.

JOB TITLE: Public Information and Education

PERIOD COVERED: October 1, 1985 to September 30, 1986.

OBJECTIVES

To inform and educate the public of the need to conserve, restore, and wisely manage the island's fish and wildlife resources as it can be accomplished through the Division's Federal Aid Programs.

RESULTS

This job was inactive throughout this segment due to funding uncertainties and lack of manpower.

RECOMMENDATION

Activate this job during the next segment provided adequate funding and manpower are available.

Report prepared by Robert D. Anderson

GUAM FISHERIES INVESTIGATIONS
PROJECT FW-2R-23
Federal Aid in Sport Fish Restoration Act

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 1

JOB TITLE: Offshore Fisheries Survey

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Monthly offshore fisheries surveys were conducted at the Agana Boat Basin and other boat launching locations along Guam's shoreline from October 1985 through September 1986. An island-wide finfish catch is estimated at 265.0 metric tons (m.t.) for that period. The bulk of the catch, 222.6 m.t., was harvested by trolling during an estimated 47,984 boat hrs. of effort. Bottomfishing produced an estimated 20.0 m.t., primarily deepwater snappers, followed by night-light jigging for atulai (11.5 m.t.) and spearfishing (7.4 m.t.). Approximately 3.5 m.t. of finfish and shelfish were landed by spincasting, gill netting, or collected by hand while diving. (Catches by infrequently encountered methods may be under-estimated as follows: night-light jigging for atulai (30%); spearfishing (21%); other methods combined (25%).)

BACKGROUND

Effective management of the island's offshore fishery resources requires accumulating data on fishing pressure, types of fishing methods used and annual harvest. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlife Resources (DAWR) has been monitoring offshore fishing activities for the past ten years. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. Recently, however, major advances have been made in both field survey techniques and in the area of computerized statistical analysis. Much of this progress has resulted from the combined efforts of DAWR and National Marine Fisheries Service (NMFS) personnel through the Western Pacific Fisheries Information Network (WPACFIN) program (see Study F-1, Job 3).

OBJECTIVES

1. To quantify fishing participation, effort, and catch which occurs outside the reef margin in boats.

2. To collect biological data from the specimens examined during interviews.

PROCEDURES

During FY 86, interviews of returning offshore fishing parties were conducted on four days each month at the Agana Boat Basin. Two of these days were randomly selected

weekdays and two were randomly selected weekend days (which in this report includes holidays). Each survey consisted of two periods, one from 0500 to 1100 hours and the other from 1600 to 2400 hours.

Sampling and analytical procedures used in the GOES (Guam offshore expansion system) and by the Division remain unchanged from those outlined in the FY 85 annual report.

RESULTS

Trolling

Estimated monthly and annual trolling participation, effort and harvest which occurred during FY 86, icluding the Guam International Fishing Derby (GIFD), are given in Table 1. An estimated 222.6 m.t. of troll-caught fish were landed island-wide during FY 86. Monthly catches ranged from a high of 38.3 m.t. in November to a low of 9.4 m.t. in July (Figure 1). An estimated 47,984 boat-hours were spent trolling with an average catch rate of 4.6 kg/boat-hour. Monthly catch rates (CPUE) ranged from 5.8 kg/boat-hour in September to 1.9 kg/boat-hour in July.

The usual five pelagic species accounted for the bulk of the catch (95.9%; Table 2; Figure 2). Wahoo (*Acanthocybium solandri*; 36.0%) was the most important species, followed by skipjack tuna (*Katsuwonus pelamis*; 15.7%); mahimahi (*Coryphaena hippurus*; 25.9%); yellowfin tuna (*Thunnus albacares*; 10.2%), and blue marlin (*Makaira nigricans*; 8.1%). Scombrids collectively comprised 62.5% of the total trolling harvest.

As in the previous year, the FY 86 trolling harvest was atypical in several respects. Catches were generally poor, but for the first time the wahoo catch exceeded that of all other species. The wahoo catch reached an all-time high of 81.7 m.t., 33.3% more than the record-setting FY 85 catch which was itself more than twice the catch of FY 84. The mahimahi catch exceeded that of FY 85 by 25.6%, continuing to rise from the extemely poor catch of FY 84. A small number of sailfish, which were not encountered during the FY 85 survey,were caught during FY 86 (1.4 m.t.). Catches of all other major species dropped considerably from the catches of FY 85 as follows: skipjack tuna (-42.8%), yellowfin tuna (-51.4%), blue marlin (-43.8%), and great barracuda (-17.4%). The overall poor catches of skipjack tuna, yellowfin tuna, and blue marlin contributed to a drop in the CPUE from 5.8 kg/boat-hour in FY 85 to 4.6 kg/boat-hour in FY 86. This was a continuation of the downward slide from the catch rate of FY 84 (6.5 kg/boat-hour). The overall poor catch rate and decrease in participation during FY 86 resulted in a catch 12.7% lower than the historically high catch of FY 85.

Bottomfishing

The estimated monthly and annual bottomfishing participation, effort, and harvest which occurred during FY 86 is shown in Table 3. An estimated 20.0 m.t. of bottomfish were harvested island-wide. Monthly catches ranged from a high of 5.3 m.t. in July to a low of no encountered catch in January. In general, catches fluctuated widely from October to March, then stabilized between 1.2 and 1.7 m.t. from May to September (Figure 1). An estimated 7,826.3 boat-hours were spent bottomfishing, resulting in an overall catch rate of 2.6 kg/boat-hour. Monthly catch rates ranged from 1.3 kg/boat-hour in March to 5.9 kg/boat-hour in February.

As in most years, the snapper family (Lutjanidae) was the most important accounting for 42.1% of the catch, followed by jacks (Carangidae; 24%) and emperors (Lethrinidae;

Table 1. Estimated monthly and annual trolling participation, effort and harvest during FY 86. Estimates include the GIFD.

A) PARTICIPATION:

MONTH	NO. OF PERSONS	SE	90% CL	NO. OF BOAT-TRIPS	SE	90% CL
OCT	2031.4	322.4	758.5	795.8	139.4	328.0
NOV	3550.4	1605.7	3778.3	1327.9	544.5	1304.6
DEC	1784.1	93.9	221.0	712.1	32.9	77.4
JAN	1355.8	627.8	1477.2	489.0	183.6	432.0
FEB	1788.7	390.6	919.1	689.3	190.3	447.8
MAR	3284.1	297.8	700.8	1069.8	15.0	35.3
APR	1803.5	449.0	1056.6	614.5	195.4	459.9
MAY	2383.2	424.9	999.7	797.2	167.5	394.2
JUN	2609.3	376.1	885.0	856.1	147.1	346.1
JUL	2156.2	355.3	836.0	1674.3	117.2	275.8
AUG	1779.3	917.2	2158.2	689.1	404.9	952.7
SEP	922.9	137.3	323.1	373.8	83.4	196.2
TOTAL	25448.9			10118.9		
GOES	25258.2	1845.0	3107.0	10044.8	663.3	1117.0

B) EFFORT:

MONTH	NO. OF PERSON-HOURS	SE	90% CL	NO. OF BOAT-HOURS	SE	90% CL
OCT	8296.0	1503.9	3538.6	3351.0	636.4	1497.4
NOV	17591.4	8207.0	19311.0	6769.0	2834.2	6668.9
DEC	10493.3	955.8	2248.9	4154.0	373.8	879.5
JAN	6916.0	2880.2	6777.0	2552.7	880.7	2072.2
FEB	12714.5	2616.5	6156.7	4861.2	1214.1	2856.8
MAR	14355.7	2409.4	5669.3	4670.0	715.5	1683.5
APR	10130.6	3626.6	8533.3	3548.3	1480.5	3483.6
MAY	11279.6	980.8	2307.8	3743.3	438.6	1032.0
JUN	13728.3	2626.4	6180.0	4672.8	1034.9	2435.2
JUL	13342.8	2383.5	5608.4	4989.7	745.4	1753.9
AUG	7922.7	4042.2	9511.4	3067.4	1791.2	4214.6
SEP	4686.4	1090.7	2566.5	1952.3	584.3	1374.2
TOTAL	131457.3			48331.7		
GOES	130599.3	9865.9	16614.2	47984.1	3683.5	6203.0

C) HARVEST:

MONTH	NO. OF KILOGRAMS	SE	90% CL	Kg/B-T	Kg/B-H	Kg/P-H
OCT	14504.8	7292.5	17159.4	18.2	4.3	1.8
NOV	38345.9	21317.5	50160.0	28.2	5.7	2.2
DEC	23884.0	6977.2	16417.3	33.5	5.7	2.3
JAN	13517.6	3238.8	7621.0	27.6	5.3	2.0
FEB	25449.7	5432.7	12783.3	36.9	5.2	2.0
MAR	24927.5	2409.9	5670.4	23.3	5.3	1.7
APR	18066.1	10227.8	24066.0	29.4	5.1	1.8
MAY	18313.0	4780.8	11249.1	23.0	4.9	1.6
JUN	18169.7	5186.0	4672.8	21.2	3.9	1.3
JUL	9360.4	425.2	1000.5	5.6	1.9	0.7
AUG	11225.2	8069.2	18986.9	16.3	3.7	1.4
SEP	11413.2	2882.6	6782.7	30.5	5.8	2.4
TOTAL	227177.1			22.6	4.7	1.7
GOES	222583.3	25706.7	43290.0	22.2	4.6	1.7

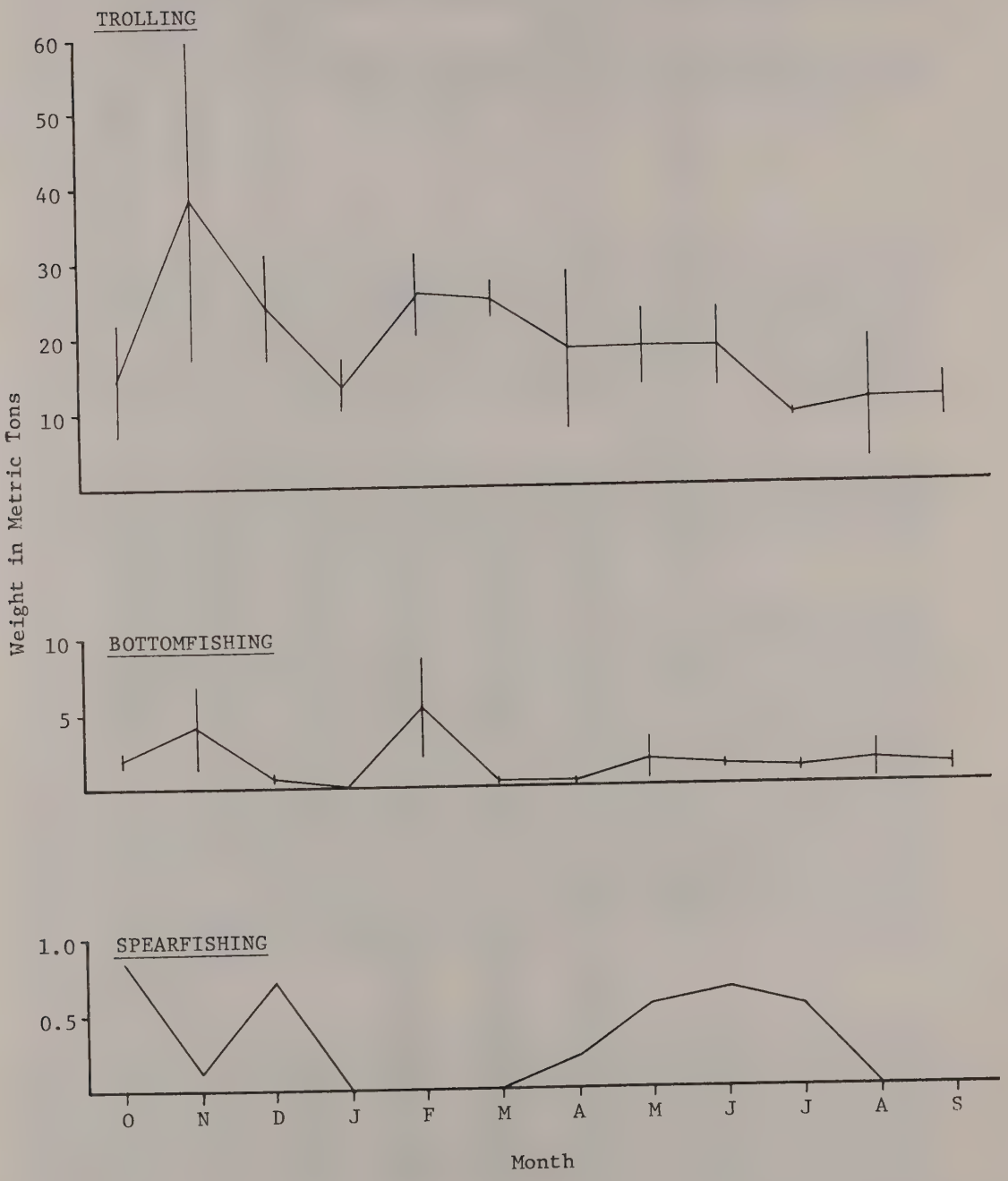

Figure 1. Monthly fluctuations in the estimated Guam offshore fish harvests during FY 86. The trolling estimate includes the GIFD. Vertical lines denote the standard error (not available for spearfishing).

Table 2. Monthly and annual composition of the Guam trolling harvest during FY 86. Estimated weights are in metric tons and include the GIFD catch.

FAMILY AND SPECIES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL	% TOTAL
Belonidae														
Ablennes hians					16.9								16.9	<0.1
Carangidae														
Carangoides orthogrammus		11.6											11.6	<0.1
Caranx ignobilis								661.7					661.7	0.3
C. melampygus		83.0			100.1								183.1	0.1
Elagatis bipinnulatus	121.4	58.0	87.7		483.8				23.1		4.2	19.2	797.5	0.4
Unid. carangids	7.6													
Coryphaenidae														
Coryphaena hippurus	345.3	2961.1	658.4	7070.9	8107.0	19810.6	12586.4	6653.0	669.6	61.5	10.6	17.0	58951.5	25.9
Lutjanidae														
Aphareus furcatus		32.7							5.1				37.2	<0.1
Sphyraenidae														
Sphyraena barracuda	436.3	247.3			1746.0		88.9	118.5		213.4			2850.4	1.3
S. genie	121.4												121.4	<.1
Scombridae														
Acanthocybium solandri	8900.9	28772.0	16826.3	2812.4	10616.0	2729.0	1554.1	2027.8	6160.7	746.5	221.6	359.9	81727.2	36.0
Euthynnus affinis	364.2	102.3	46.8							4.1			517.4	0.2
Gymnosarda unicolor	500.8	42.7	131.7	62.4	139.0					9.7		43.7	867.6	0.4
Katsuwonus pelamis	1088.9	3379.4	3037.3	1898.9	2040.7	627.8	1461.2	7051.3	5021.5	2059.8	3506.0	4485.4	35658.3	15.7
Thunnus albacares	2219.5	2594.8	2457.9	1735.5	2200.2	108.9	499.6	582.1	2091.6	1227.7	5150.3	2392.3	23261.0	10.2
Unid. scombrids		61.6											61.1	<0.1
Istiophoridae														
Istiophorus platypterus			637.9				730.6						1368.5	0.6
Makaira nigricans	398.4						1145.3	1218.0	4198.1	4964.7	2332.4	4095.8	18352.7	8.1
Unspecified							1651.2			71.1			1722.3	0.8
TOTAL	14504.8	38345.9	23884.0	13517.6	25449.7	24927.5	18066.1	18313.0	18169.7	9359.4	11225.2	11413.2	227176.1	100.0

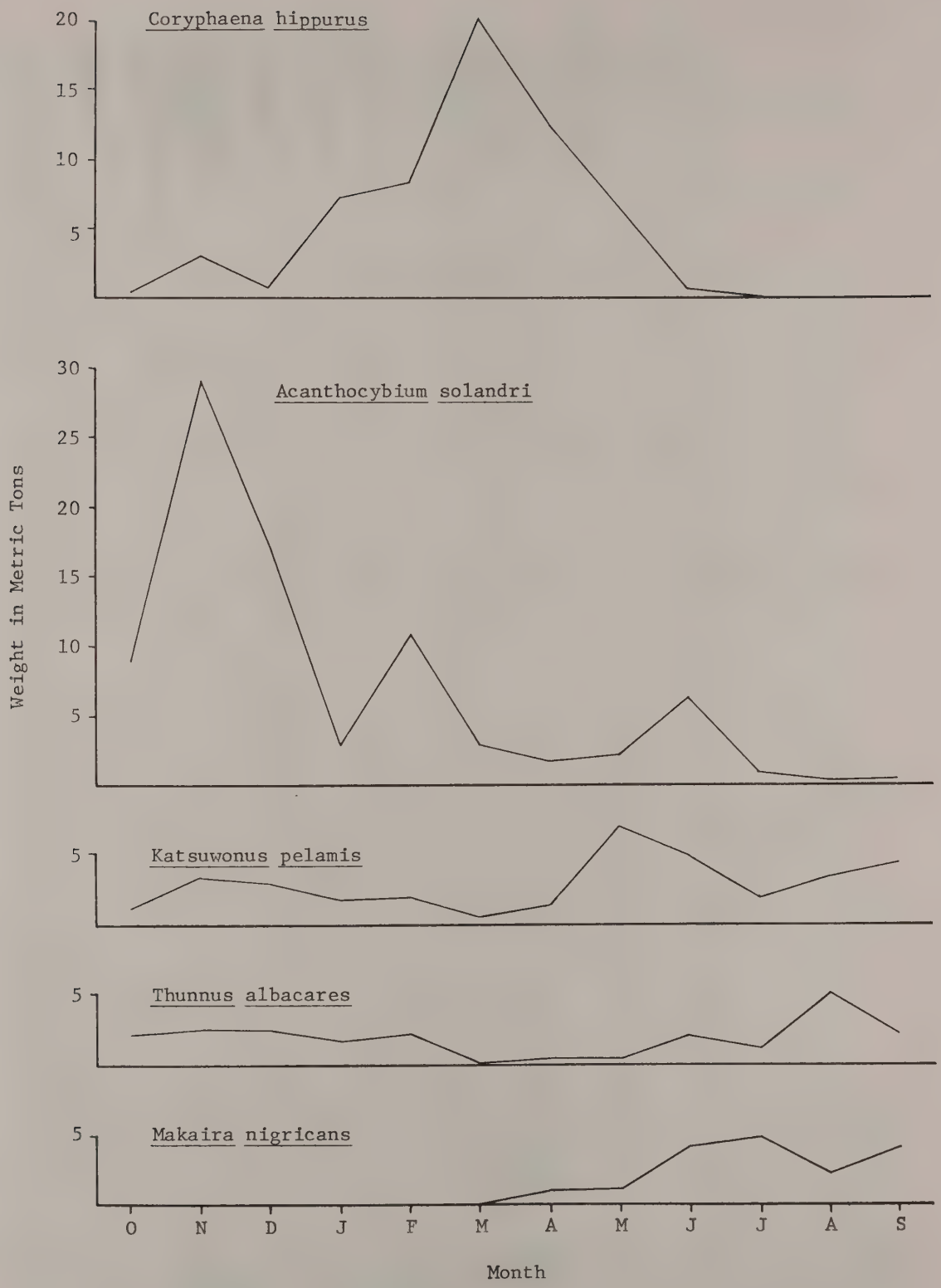

Figure 2. Monthly fluctuations in the estimated harvest of Guam's major troll-caught species during FY 86. Estimates include the GIFD.

Table 3. Estimated monthly and annual Guam bottomfishing participation, effort and harvest during FY 86. See text for explanation.

A) PARTICIPATION:

MONTH	NO. OF PERSONS	SE	90% CL	NO. OF BOAT-TRIPS	SE	90% CL
OCT	812.4	161.7	380.5	274.2	66.0	155.2
NOV	932.4	433.0	1018.8	323.7	131.8	310.2
DEC	364.4	49.3	116.1	131.0	17.3	40.6
JAN	0	0	0	0	0	0
FEB	448.6	131.9	310.4	163.7	45.6	107.2
MAR	238.6	103.4	243.4	78.0	23.5	55.2
APR	130.3	33.6	79.1	51.7	15.7	37.0
MAY	339.3	255.6	601.3	113.1	85.2	200.4
JUN	537.9	189.6	446.2	204.1	55.5	130.5
JUL*	411.0	70.3	165.5	191.3	35.1	82.7
AUG	399.8	324.9	764.5	163.3	117.3	276.0
SEP	152.4	50.4	118.7	86.1	34.4	80.9
TOTAL	4767.1			1780.2		
GOES**	4790.3	654.2	1101.6	1802.5	231.3	389.5

B) EFFORT:

MONTH	NO. OF PERSON-HOURS	SE	90% CL	NO. OF BOAT-HOURS	SE	90% CL
OCT	3760.7	1053.9	2479.7	1273.5	408.1	960.2
NOV	4568.7	2752.7	6477.0	1535.0	848.2	1995.9
DEC	1345.8	75.3	177.2	479.0	44.8	105.4
JAN	0	0	0	0	0	0
FEB	2438.3	1213.5	2855.3	885.6	430.1	1012.1
MAR	757.6	478.3	1125.5	240.8	150.9	355.2
APR	364.4	80.5	189.5	137.7	27.8	65.4
MAY	2165.2	1697.0	3993.1	721.7	565.7	1331.0
JUN	2195.0	387.9	912.8	869.6	79.0	185.9
JUL	1301.9	233.9	550.3	597.3	105.9	249.3
AUG	1467.2	1244.9	2929.2	556.9	434.9	1023.2
SEP	717.5	247.9	583.4	471.1	244.3	575.0
TOTAL	21082.3			7768.2		
GOES	21069.4	3493.5	5883.1	7826.3	1210.8	2039.0

C) HARVEST:

MONTH	NO. OF KILOGRAMS	SE	90% CL	Kg/B-T	Kg/B-H	Kg/P-H
OCT	1958.0	553.7	1302.8	7.1	1.5	0.5
NOV	4054.8	2788.5	6561.3	12.5	2.6	0.9
DEC	762.0	198.2	466.3	5.8	1.6	0.6
JAN	0	0	0	-	-	-
FEB	5260.4	3258.8	7668.0	32.1	5.9	2.2
MAR	314.7	169.4	398.7	4.0	1.3	0.4
APR	266.3	88.4	208.1	5.2	1.9	0.7
MAY	1734.7	1383.5	3255.5	15.3	2.4	0.8
JUN	1374.2	289.5	681.3	6.7	1.6	0.6
JUL	1157.6	354.5	834.2	6.1	1.9	0.9
AUG	1538.7	1246.8	2933.7	9.4	2.8	1.1
SEP	1164.7	543.9	1279.9	13.5	2.5	1.6
TOTAL	19586.1			11.0	2.5	0.9
GOES	20016.4	5066.5	8532.0	11.1	2.6	1.0

*Results are based on a 28 day expansion on the assumption that bottomfishing was negligible during the three day GIFD.

**Results are based on a 362 day expansion based on the assumption that bottomfishing was negligible during the three day GIFD.

15.9%) (Table 4). The catch of emperors which for the first time exceeded that of snappers in FY 85 (44.0%), dropped considerably, while the catch of jacks rose (from 5.6% in FY 85). Deepwater species (*Etelis spp., Pristipomoides spp.*) comprised the bulk of the snapper catch (64.9%, or 23% of the overall catch). The four most important species of deepwater snapper were the yellowtail kalikali (*P. auricilla*), followed by the yellow-eyed opakapaka (*P. filamentosus*), gindai (*P. zonatus*), and silver-mouth (*Aphareus rutilans*). Uku (*Aprion virescens*) and tagafe (*Lutjanus bohar*) comprised 80.6% of the shallow-water snapper catch. The redgilled mafute (*Lethrinus rubrioperculatus*) which was the most important single bottomfish species in FY 85 (33.9% of the overall bottomfishing catch) was the second most important bottomfish species (5.4%) in FY 86. Other important families included the groupers (Serranidae; 6.4%), squirrelfishes (Holocentridae; 3.3%), triggerfishes (Balistidae; 1.7%), and goatfishes (Mullidae; 1.1%) which were landed primarily at relatively shallow depths.

Spearfishing

The estimated monthly and annual participation, effort, and harvest for spearfishing from boats during FY 86 is summarized in Tables 5 and 6. (Readers should also refer to study F-1, Job 2 for estimates of spearing from shore, i.e., without the use of boats, to gain a more complete picture of FY 86 spearfishing activities on Guam.)

An estimated 7.4 m.t. of speared fish, crustaceans, and octopuses were landed from boats during FY 86. This was a drop of 24% from the catch of FY 85. Unlike FY 85, the bulk of the FY 86 catch was taken by snorkelers (5.5 m.t.) rather than by SCUBA divers (1.4 m.t.). An estimated 1,168.8 boat-hours of fishing effort were expended by spearfishers, the bulk of which was due to snorkeling (983 vs. 153 boat hours, with 33 boat-hours unknown). The average catch rate for spearfishing was approximately 6.3 kg/boat-hour, unchanged from that of FY 85, but the catch rate for spearfishermen using SCUBA greatly exceeded that of snorkelers (9.0 vs. 5.6 kg/boat-hour. Since some spearfishing parties return late at night outside our survey period and the GOES only considered complete interviews, we believe that the above estimates are low. Based on days in which participation in spearfishing occurred, but interviews were not obtained, it is believed that the GOES expansion for FY 86 underestimates the spearfishing catch by 21%.

Parrotfishes (Scaridae; 33.7%) clearly dominated the FY 86 spearfishing catch (Table 7). Groupers (Serranidae; 13.4%), were a distant second, followed by surgeonfishes (Acanthuridae; 11.0%), rudderfishes (Kyphosidae; 6.1%), snappers (Lutjanidae; 4.5%), squirrelfishes (Holocentridae; 3.7%), wrasses (Labridae; 3.7%), and emperors (Lethrinidae; 1.9%). In addition to fishes, an estimated 0.6 m.t. (7.7%) of crustaceans (primarily spiny lobsters) were harvested during FY 86. The mollusk catch (primarily octopuses) was insignificant.

Atulai Night-Light Jigging

Changes in the sampling period and method of determining participation implemented in FY 85 made it possible to account for the bulk of offshore atulai fishing during the past two years.

Atulai fishing was encountered in November and December 1985 and from June to August, 1986, and at least one interview was obtained during each of these months. An estimated 11.5 m.t. of atulai were landed by night-light jigging from boats during FY 86, representing a drop of about 38% from the FY 85 catch. The catch rate for FY 86 (7.6 kg/boat-hour) was considerably better than that for FY 85 (4.3 kg/boat-hour), but a 65% drop in effort (to 1,521 boat-hours) resulted in the lower catch. Even with the

Table 4. Composition of the Guam bottomfishing harvest during FY 86. Estimated weights are in metric tons. Percentages are based on the differentiated portion of the catch only.

FAMILY	WEGHT (Kg)	%
Carcharhinidae (Requiem sharks)	109.1	0.7
Holocentridae (Squirrelfishes)	730.5	4.5
Serranidae (Groupers)	1,046.5	6.4
Carangidae (Jack)	3,983.8	24.4
Lutjanidae (Snappers)	6,881.9	42.1
Lethrinidae (Emperors)	2,596.0	15.9
Mullidae (Goatfishes)	184.2	1.1
Sphyraenidae (Barracudas)	55.5	0.3
Labridae (Wrasses)	149.7	0.9
Scombridae (Tunas)	139.6	0.9
Balistidae (Triggerfishes)	282.7	1.7
Triodontidae (Pelagic puffer)	109.6	0.7
*Others	76.8	0.5
SUBTOTAL	16,346.3	100.1
Undifferentiated	3,239.7	
TOTAL	19,586.0	

*Includes Muraenidae, Dactylopteridae, Priacanthidae, Apogonidae, Malacanthidae, Nemipteridae, Acanthuridae, and Tetraodontidae, each of which comprised less than 0.1% of the catch.

Table 5. Estimated monthly and annual Guam offshore spearfishing (all methods) participation, effort and harvest during FY 86. See text for explanation.

MONTH	PARTICIPATION NO. Of PERSONS	PARTICIPATION NO. OF BOAT-TRIPS	EFFORT NO. OF PERSON-HRS.	EFFORT NO. OF BOAT-HRS.	HARVEST NO. OF KILOGRAMS	HARVEST Kg/B-T	HARVEST Kg-B-H	HARVEST Kg/P-H
OCT	204.2	65.5	565.2	258.5	1,700.8	26.0	6.6	3.0
NOV	216.1	71.8	655.9	190.5	217.6	3.0	1.1	0.3
DEC	107.7	46.8	202.6	111.3	1,411.7	30.2	12.7	7.0
JAN	0	0	0	0	0	-	-	-
FEB	15.4	7.7	15.4	7.7	3.3	0.4	0.4	0.2
MAR	0	0	0	0	0	-	-	-
APR	60.7	25.7	74.7	30.4	391.7	15.2	12.9	5.2
MAY	97.2	38.8	213.9	97.2	1,113.0	28.7	11.5	5.2
JUN	163.3	49.9	757.6	244.0	1,304.2	26.1	5.3	1.7
JUL	104.1	54.9	342.7	195.1	1,074.4	19.5	5.5	3.1
AUG	30.6	10.2	122.4	40.8	195.9	19.2	4.8	1.6
SEP	90.5	20.0	159.1	29.0	42.5	2.1	1.5	0.3
TOTAL	1,089.8	391.3	3,109.5	1,204.5	7,455.1	19.1	6.2	2.4
GOES	1,060.1	381.0	2,990.7	1,168.8	7,399.2	19.4	6.3	2.5

Table 6. Estimated annual Guam offshore spearfishing participation, effort and harvest by method during FY 86. See text for explanation.

A) PARTICIPATION

	NO. OF PERSONS	SE	90% CL	NO. OF BOAT-TRIPS	SE	90% CL
Snorkel	550.4	159.0	267.7	235.2	64.7	109.0
Scuba	451.2	146.7	247.1	131.2	41.3	69.6
Unknown or both	58.5	55.6	93.6	14.6	13.9	23.4
Total Spearfishing	1,060.1			381.0		

B) EFFORT

	PERSON-HOURS	SE	90% CL	BOAT-HOURS	CE	90% CL
Snorkel	2,314.3	711.0	1,197.3	983.1	299.3	504.1
Scuba	544.9	206.1	347.0	152.8	55.1	92.8
Unknown or both	131.5	125.0	210.5	32.9	31.3	52.6
Total Spearfishing	2,990.7			1,168.8		

C) HARVEST

	NO. OF KILOGRAMS	SE	90% CL	Kg/B-T	Kg/B-H	Kg/P-H
Snorkel	5,476.0	1,931.1	3,252.0	23.3	5.6	2.4
Scuba	1,369.4	792.1	1,333.9	10.4	9.0	2.5
Unknown or both	553.8	526.5	886.5	37.9	16.8	4.2
Total Spearfishing	7,399.2			19.4	6.3	2.5

Table 7. Composition of the Guam spearfishing harvest during FY 86.

FAMILY	SNORKEL (Kg)	%	SCUBA (Kg)	%	UNKNOWN OR MIXED (Kg)	%	TOTAL (Kg)	%
Carcharhinidae (Sharks)	69.2	1.2	59.6	4.6			128.8	1.7
Holocentridae (Squirrelfishes)	240.3	4.3	31.8	2.5	6.0	1.1	278.1	3.7
Serranidae (Groupers)	645.8	11.6	321.1	24.5	30.3	5.4	997.2	13.4
Carangidae (Jacks)	25.7	0.5	13.0	1.0			38.7	0.5
Lutjanidae (Snappers)	335.4	6.0	2.1	.2			337.5	4.5
Haemulidae (Sweetlips)	16.6	0.3					16.6	0.2
Lethrinidae (Emperors)	115.5	1.9	10.5	0.8	12.1	2.2	138.1	1.9
Mullidae (Goatfishes)	20.8	0.4	14.8	1.1	19.1	3.4	54.7	0.7
Kyphosidae (Rudderfishes)	409.7	7.3			44.2	7.9	453.9	6.1
Labridae (Wrasses)	276.9	5.0					276.9	3.7
Scaridae (Parrotfishes)	1,510.5	27.1	683.6	52.2	318.1	56.8	2,512.2	33.7
Acanthuridae (Surgeonfishes)	680.0	12.2	111.5	8.5	32.2	5.7	823.7	11.0
Siganidae (Rabbitfishes)	15.4	0.3	12.9	1.0			28.3	0.4
Bothidae (Flounders)			3.8	0.3			3.8	0.1
Monacanthidae (Filefishes)	11.9	0.2					11.9	0.2
Subtotal	4373.7	78.3	1,264.7	96.5	462.0	82.4	6,100.4	81.8
Undifferentiated Fishes	761.7	13.6					761.7	10.2
TOTAL (Finfishes)	5,135.4	92.0	1,264.7	96.5	462.0	82.4	6862.1	92.0
Trochus			5.3	0.4			5.3	0.1
Octopuses & Squids	4.2	0.1	12.2	0.9			16.4	0.2
Crabs	23.8	0.4	8.4	0.6			43.4	0.6
Spiny Lobsters	397.5	7.1	8.5	0.7	87.4	15.6	493.4	6.6
Slipper lobster	23.8	0.4	10.7	0.8			34.5	0.5
TOTAL	5,584.4		1,309.9		560.5		7,455.2	

improvements in sampling there were some days in which this method occurred but interviews could not be obtained. We believe that the GOES underestimated the catch of this method by approximately 30%.

Other Methods

Other rarely encountered methods during FY 86 include spin casting, gill-netting, diving for trochus or slipper lobster (without spears), and using a fishing line while snorkeling. Together, they produced an estimated harvest of 3.5 m.t. during 255 boat-hours of effort. It is believed that the GOES underestimated the harvest of these methods by about 25%.

Overview

Excluding the 1986 GIFD trolling catch an estimated 265.0 m.t. (90% confidence limit (CL) = 53.9 m.t.) of finfish were landed island-wide by boats utilizing a variety of methods beyond the reef margin during FY 86. An estimated 10,138 boat trips were made in which 58,755 boat-hours were spent fishing. Excluding the GIFD, the average daily participation was estimated at 16.2 boats per weekday and 46.9 boats per weekend day or holiday. Including the GIFD, the overall monthly catch rates (kg/boat-hour) ranged from 3.2 in March to 6.6 in September with an average of 4.5, an 8% drop from the 4.9 average of the previous year and a 24% drop from the 5.9 average of FY 84. Trolling accounted for 84.0% of the FY 86 harvest (222.6 m.t., 90% CL = 43.3 m.t.), bottomfishing comprised 7.6% of the harvest (20.0 m.t.; 90% CL = 5.1 m.t.), jigging for atulai accounted for 4.3% of the harvest (11.5 m.t.; 90% CL = 11.2 m.t.), spearfishing accounted for 2.8% (7.4 m.t.; CL not available) of the harvest, and other rare methods accounted for the remaining 1.3% (3.5 m.t.) of the harvest. Catches for all four of the major fisheries were down considerably from those of FY 85 as folows: trolling (-12.7%), bottomfishing (-40.5%), jigging for atulai (-38.8%), and spearfishing (-23.7%). This is the result of both a drop in overall participation (-14.0%) and effort (-16.6%), and a drop in the catch rate for trolling (-12.7%) and bottomfishing (-7.1%).

RECOMMENDATIONS

The GOES calculated catches presented in this report underestimate all methods other than trolling and bottomfishing to a certain extent. This is due to the fact that some boats utilizing infrequently sampled methods return during non-surveyed hours (particularly 2400 to 0500 hrs.). A survey method not utilized by the GOES has been devised to account for these boats. During FY 87 we will extend our survey to one weekend/holiday and one weekday per month at the Merizo Pier. It is anticipated that this will result in a more accurate island-wide catch estimate than that of previous years. Therefore, we recommend that this job continue and that sampling techniques continue to be refined. Furthermore, we recommend that staff fisheries biologists continue to work closely with NMFS personnel in improving the efficiency and accuracy of our computerized data analysis techniques.

Report prepared by: Robert F. Myers

PROJECT TITLE: Guam International Fishing Derby

PERIOD COVERED: July 18-20, 1986.

INTRODUCTION

The tenth Guam International Fishing Derby (GIFD), sponsored by the Guam Fishermen's Cooperative Association, was held on July 18, 19, and 20, 1986. The organizational efforts of the Derby Committee chaired by Johnny S. Chaco made this year's event a successful one. The fisheries biologists from the Division of Aquatic & Wildlife Resources (DAWR) wish to thank the committee for their assistance, and also the competing anglers for their cooperation in providing catch information. This cooperation always helps make our job easier and more enjoyable and insures a more accurate collection of data.

Awards were presented to the anglers who landed the first, second, and third heaviest fishes of the following species: blue marlin *(Makaira nigricans)*, yellowfin tuna *(Thunnus albacares)*, wahoo *(Acanthocybium solandri)* and mahimahi *(Coryphaena hippurus)*. As in the past derbies, awards were also given for the greatest 3-day total number of fish caught in the above categories combined, as well as for the largest fish caught in a ladies category, and in a children under age 16 category. Records were also kept in an "other species" category.

PARTICIPATION

As in the past, onshore check-out/check-in stations were set up at the Agana Boat Basin and the Merizo Pier. Daily participation information is listed in Table 1. A total of 248 separate boat trips were recorded during this year's derby with 207 (83.5%) of these trips originating from the Agana Boat Basin. Each boat carried an average of 2.9 anglers per trip and pulled an average of 4.2 lines per trip, compared to last year's figure of 3.0 anglers per trip pulling an average of 4.0 lines. The mean fishing trip length of the 1985 GIFD was 8.3 hrs., shorter than that of last year's derby (10.0 hrs.).

THE CATCH

A total of 237 fish weighing 3,795 kg were caught during the 1985 GIFD. This includes other species as well as the four main derby species (Table 2). The mean catch per boat trip was 15.3 kg, less than half the 33.9 kg per boat trip of last year's GIFD. Like the overall catch rate, the catch rate for the major fishing areas as well as the catch rates for each of the five derby species were considerably lower than those of last year's derby. The catch rate for blue marlin greatly exceeded those for all other species (.75 vs .02 to .11 kg/boat-hour fished).

Fourty-seven blue marlin were caught this year, nearly tying the 1984 record total of more than 50 (Table 3). Their collective weight of 2,859.1 kg greatly exceeded that of the 1985 catch, but the average size (60.8 kg) was considerably smaller (60.8 kg vs 97.6 kg in 1985). However, this year's winning marlin weighed 173.9 kg, slightly smaller than last year's 178.0 kg winner.

The yellowfin tuna catch was considerably smaller than that of last year's derby, consisting of 71 individuals totaling 406.0 kg. The average size of those caught also was smaller (5.7 vs. 7.7 kg caught last year), but this year's 46.0 kg winner weighed about the same as last year's (45.9 kg).

Table 1. Daily participation, effort and catch in the tenth annual Marianas fishing derby.

	DAY 1 JULY 18	DAY 2 JULY 19	DAY 3 JULY 20	DERBY TOTALS
Number of boats	71	74	70	93
Number of boat trips	86	89	73	248
Number of fishermen	236	270	222	728
Average men per boat	2.7	3.0	3.0	2.9
Number of lines fished	368	380	300	1048
Average lines per boat	4.3	4.3	4.1	4.2
Boat hours	711.2	664.0	692.7	2067.8
Average boat trip length	8.3	7.5	9.5	8.3
Fisherman hours	1970.3	1966.9	2103.0	6040.2
Line hours	3117.3	2902.6	2872.1	8891.9
Number of fish landed	94	93	50	237
Kilograms landed	1386.7	1671.3	737.0	3795.0
Average catch per boat trip	16.1	18.8	10.1	15.3
Average catch per boat hour	1.9	2.5	1.1	1.8
Average catch per man hour	.7	.8	.4	.6
Average catch per line hour	.4	.6	.3	.4

Table 2. Daily catch composition for the tenth annual Marianas fishing derby.

	DAY 1 - JULY 18			DAY 2 - JULY 19			DAY 3 - JULY 20			TOTAL		
	NUMBER CAUGHT	TOTAL WT-KGS	AVE WT.	NUMBER CAUGHT	TOTAL WT-KGS	AVE WT.	NUMBER CAUGHT	TOTAL WT-KGS	AVE WT.	NUMBER CAUGHT	TOTAL WT-KGS	AVE WT.
MARLIN	18	1025.1	56.9	20	1283.1	64.2	9	551.0	61.2	47	2859.1	60.8
YELLOWFIN TUNA	28	143.2	5.1	25	178.7	7.1	18	84.1	4.7	71	406.0	5.7
WAHOO	6	47.7	8.0	7	62.4	8.9	3	26.6	8.9	16	136.7	8.5
MAHIMAHI	2	24.1	12.1	2	28.5	14.3	3	8.8	2.9	7	61.5	8.8
SKIPJACK TUNA	15	70.3	4.7	15	57.0	3.8	6	26.5	4.4	36	153.8	4.3
RAINBOW RUNNER	0	0	0	0	0	0	1	.9	.9	1	.9	.9
BARRACUDA	9	38.3	4.3	4	21.6	5.4	7	31.5	4.5	20	91.3	4.6
OTHER	16	37.1	2.3	20	40.1	2.0	3	7.7	2.6	39	84.9	2.2
TOTALS	94	1385.7	14.7	93	1671.3	18.0	50	737.0	14.7	237	3794.0	16.0

Table 3. Catch comparison for all Guam or Marianas Fishing Derbies.* Weights are expressed in kilograms (1Kg = 2.2 lbs).

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
MARLIN										
no. caught	9	9	6	12	34	12	13	79	17	47
total weight (kg)	933.0	511.0	703.0	727.0	2005.0	852.0	964.1	3645.9	1659.7	2859.1
av. weight (kg)	103.6	56.8	117.2	60.6	59.0	71.0	74.2	46.1	97.6	60.8
winning fish (kg)	192.0	75.2	328.0	139.0	145.0	132.0	199.1	215.4	178.0	173.9
YELLOWFIN										
no. caught	18**	11	34	50	109	205	100	91	137	71
total weight (kg)	240.0	255.0	637.0	308.0	1156.0	2377.0	1105.7	479.1	1058.2	406.0
av. weight (kg)	13.3	23.2	18.7	6.2	10.6	11.6	11.1	5.3	7.7	5.7
winning fish (kg)	46.3	56.8	67.7	51.1	47.7	61.1	55.7	51.7	45.9	46.0
WAHOO										
no. caught	7	9	11	12	33	60	36	84	98	16
total weight (kg)	90.9	102.0	116.0	161.0	543	264.0	359.7	595.3	921.6	136.7
av. weight (kg)	13.0	11.4	10.5	13.4	16.5	4.4	10.0	7.1	9.4	8.5
winning fish (kg)	22.3	18.9	19.7	23.4	17.0	22.7	24.5	21.3	23.5	17.7
MAHIMAHI										
no. caught (kg)	2	4	5	3	1	14	33	0	14	7
total weight (kg)	13.6	26.4	52.6	39.3	0.8	63.7	195.2	-	76.6	61.5
av. weight (kg)	6.8	6.6	10.5	13.1	-	4.6	5.9	-	5.5	8.8
winning fish (kg)	8.9	8.9	14.8	15.9	0.8	14.8	11.1	-	14.8	14.7
DERBY SPECIES CATCH										
no. caught	36	33	56	77	177	291	182	254	266	141
total weight (kg)	1277.5	894.4	1508.6	1235.3	3704.8	3556.7	2624.7	4720.3	2716.1	3463.3
TOTAL CATCH**										
no caught	-	-	-	-	-	-	281	472	427	237
total weight (kg)							3277.6	5466.4	4370.2	3794.0

*Based on return catch reports. Only the principal derby species are included.
**Includes all tuna species.

This year's derby produced an extremely poor wahoo catch of just 16 fish weighing 136.7 kg., far below the record of 98 set last year. The average weight of 8.5 kg was slightly below the 9.4 kg average of last year's derby. The winning wahoo weighed 17.7 kg, also smaller than last year's winner.

Seven mahimahi weighing 61.5 kg were landed, a drop from last year's catch of 14. However, the average size was greater (8.8 vs. 5.5 kg.) but this year's 14.7 kg winner weighed about the same as last year's (14.8 kg).

Ninety-six individuals of at least four "non-derby" species were landed accounting for 8.7% (330.7 kg) of the overall derby catch. Nearly half of this (46.5%) consisted of skipjack tuna (bonita). The remainder consisted of barracuda (27.6%) , rainbow runner (0.3%) and unidentified fishes (25.7%).

FISHING AREAS

As in all other years, most of this year's effort was spent off northern Guam (83.5% of the individual boat trips and 75.2% of fished hours reported by location; Table 4). In all major areas the catch rate for blue marlin greatly exceeded those for all other species (.75 vs .02 to .11 kg/b-h (boat-hour fished)). Unlike last year when the overall catch rate was similar in both northern and southern fishing grounds, catch rates in the south during the 1986 derby were more than double those in the north (1.59 vs. .72 kg/b-h, respectively). The most productive area was the southern coastal region (1.73 kg/b-h), followed by the southern banks (.97 kg/b-h) and the northern banks (.63 kg/b-h). The relatively high productivity of the southern coastal region resulted in coastal fishing trips being more productive than trips that included offshore banks (1.55 kg/b-h vs .77 kg/b-h, respectively). In spite of the higher catch rates in the south, the greater effort in the north increased the chances of a winning fish being caught there. All of the first place fish were caught in the north: the winning blue marlin and mahimahi were caught off Ritidian Point, the winning yellowfin tuna was caught off Rota Banks, and the wining wahoo was caught off Agana.

Report prepared by: Robert F. Myers

Table 4. Effort and catch rates for derby species during the 1986 GIFD.

Area	Effort (boat-hours fished)	Catch Rate (Kg/boat-hour fished) Mahimahi	Wahoo	Yellowfin Tuna	Blue Marlin	Total (Derby spp. only)
North (Σ all trips)	1,151.5	.02	.04	.04	.62	.72
N.W. & N.E. coast & banks (Σ all trips incl. banks)	1,129.2	.02	.03	.04	.63	.72
Rota Bank only	106.7	<.01	.16	.43	1.26	1.42
N.E. banks only	77.6		.15		1.34	1.49
N.E. - Tarague only	22.3		.05	.17		.67
N.W. & S.W.	71.0	.46			1.22	1.68
South (Σ all trips)	380.1		.05	.36	1.17	1.59
S.E. & S.W.	5.5					
S.W. coastal areas	175.4			.18	1.56	1.73
Agat Bay only	5.5		1.32			1.32
Cocos area only	14.5			2.85		2.85
S.W. banks (Σ all trips)	179.3		.06	.36	.97	1.38
11-mile Bank	34.5			.21	1.40	1.61
Galvez Bank	50.5		.20	.06	1.51	1.78
Baby Banks	27.8			1.02		1.02
White Tuna banks	24.5			.88		.88
Unspecified	42.0			.11	1.15	1.26
Σ Coastal trips	312.1	.10	.06	.24	1.15	1.55
Σ Trips including banks	1,342.9		.03	.08	.66	.77
OVERALL	1,655.0	.02	.04	.11	.75	.92

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 2

JOB TITLE: Inshore Fisheries Survey

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October, 1985 to September, 1986. The total estimated harvest for this time period was approximately 171.0 m.t. of which finfish accounted for about 91% of this total. Hook and line fishing was the most popular method accounting for about 60% of the total participation and yielding the highest estimated catch between methods at 37.9 m.t. Surround netting was the most successful method in terms of catch rate, yielding approximately 4.26 Kg/gear-hour. The goatfish (Family Mullidae) comprised almost a third of the total finfish harvest at 30.2% followed by the surgeonfish (Family Acanthuridae) at 16.5% and the triggerfish (Family Balistidae) at 12.8%. The seasonal harvest of juvenile rabbithfish (manahac) was unusually low for FY 86, accounting for only 3.8 m.t. while the seasonal harvest of bigeye scad (atulai) showed a slight increase from FY 85, contributing about 31.0 m.t. to the total inshore harvest estimate for FY 86.

BACKGROUND

Effective management of Guam's inshore fishery resources requires accumulating data on the types of fishing methods used, fishing pressure, and annual harvest. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlfie Resources (DAWR) has been monitoring marine fishing activities since the early 1960's. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. In the last several years, however, field survey techniques have been expanded and refined, while estimates of Guam's recreational/subsistence fishing activities have come to be based on more reliable data analysis techniques.

OBJECTIVES

1. To estimate the total annual inshore participation, effort and harvest of Guam's inshore recreational/subsistence fisheries through statistically valid surveys and analysis.

2. To gather limited biological data that will add to a long-term historical data base on Guam's important inshore fish species.

PROCEDURES

During FY 86, day and night "inshore participation" surveys were conducted on seven randomly selected days per month and included every type day of the week. These surveys entailed making visual observations of not only participation among the various fishing methods employed, but also of the reef zones and general locations that were fished within the more readily accessible portions of Guam's coastline (Fig. 1, locations 1-72). Based on data collected during nine years of aerial surveys conducted between FY 63 and FY 79, approximately 85% of Guam's inshore fishing activities is known to occur within this area. The starting location for each survey was selected at random and the "circular" direction of driving was alternated between surveys. Observations were made while driving the route once without backtracking. These methods were applied for both day and night participation surveys.

In addition, four "inshore-catch" survey days were selected from the seven participation days. During these catch days, a fisherman-intercept survey was conducted to gather catch, effort, and species composition data for both day and night fishing. The day survey covered a six-hour interval (starting at 0630 hours) and the night survey covered a five-hour interval (starting at 1900 hours). In the past, only one of three survey regions (Fig. 1) were selected for each "inshore-catch" day and fisheries data collection was restricted to that region. However, because of infrequently used methods (i.e., drag net and surround net), representative samples were sometimes difficult to obtain. Therefore, a broader, boundary-free survey area was used during FY 86 in order to obtain fishermen interviews for some of the rarely used methods.

The FY 86 inshore harvest estimates were calculated by a computer software package known as the Guam Inshore Expansion System (GIES). The GIES utilizes the same formulae as described in DAWR's FY 85 project report (Project No. FW-2R-22, Sub-Project F, Study No. F-1, Job No. 2).

RESULTS

During FY 86, the estimated inshore harvest for day, night, and seasonal fishing around Guam was approximately 171.0 m.t. Finfish accounted for approximately 91% of the total harvest, or about 155.7 m.t. The finfish catch resulted from a total effort of 373,718.4 person-hours and 319,146.5 gear-hours. Overall, approximately 0.42 and 0.49 Kg of fish were taken per person-hour and gear-hour, respectively. Estimated participation, effort, and catch values for each fishing method are shown in Table 1. The values in Table 1 are combined estimates of separate expansions of day, night, and seasonal harvest data collections. Tables 2 and 3 present the participation, effort, and catch for day and night fishing for each method.

Hook and line fishing was, by far, the most poplar method accounting for approximately 60% of the total participation. Also, this method yielded the highest estimated catch at 37.9 m.t. or about 22% of the total harvest. The catch rate for hook and line was about 0.16 Kg/gear-hour.

Spearfishing yielded the largest harvest for night fishing at 9848 Kg (Table 3) but accounted for only about 16% of the total harvest. The mean catch rate for this method was 1.08 Kg/gear-hour.

Various net fishing methods also contributed to the annual harvest estimates. Cast netting was the most popular net fishing method with 15009.6 participants (13% of the total) and produced about 15.5 m.t. giving a catch rate of 0.49 Kg/gear-hour. The most successful

Table 1. Combined estimated annual (FY 86) inshore fishing participation, effort, and harvest for day and night data expansions for all methods.

	No. of Persons	No. of Gear Units	No. of Trips	Person-Hours	Gear-Hours	Catch (Kg)
Hook and Line	66027.4	66298.0	34248.6	230560.5	231077.8	37890.4
Cast Net	15009.6	12963.9	11999.8	36427.2	31350.0	15461.9
Gill Net	13697.7	6569.8	5543.1	48921.2	24056.1	31676.3
Surround Net	2140.5	332.8	332.8	10017.7	1557.5	6634.1
Spearfishing	9484.5	9344.1	3336.4	25893.5	25532.9	27462.7
Drag Net	2828.6	436.7	436.7	7914.5	1205.3	2784.1
SubTotal	109188.3	95945.3	55897.4	359734.6	314779.6	121909.5
Octopus Fishing	510.6	657.5	300.0	1186.1	1626.0	664.1
"Other"	2522.4	2522.4	1888.2	6800.3	6800.3	13498.1
SubTotal	3033.0	3179.9	2188.2	7986.4	8426.3	14162.2
Atulai	2539.5	416.7	16.1	8756.7	1769.0	31137.8
Manahac	1188.6	937.0	605.6	5227.1	2597.9	3778.6
Total	115949.4	100478.9	58707.3	381704.8	327572.8	170988.1

Table 2. Estimated annual (FY 86) inshore fishing participation, effort, and harvest for daytime period for all fishing methods.

	No. of Persons	No. of Gear Units	No. of Trips	Person-Hours	Gear-Hours	Catch (Kg)	Coeff. of Var
Hook and Line	50989.4	50791.1	28143.7	184351.5	183438.4	28499.1	±7%
Cast Net	14868.2	12860.3	11896.2	36215.0	31194.6	15347.5	±10%
Gill Net	8619.9	4372.1	3422.6	36343.1	18637.4	23516.3	±7%
Surround Net	2140.5	332.8	332.8	10017.7	1557.5	6634.1	±19%
Spearfishing	4130.9	4065.4	1477.1	12597.5	12429.4	17615.1	±12%
Drag Net	163.7	46.1	46.1	457.0	125.3	305.8	±74%
SubTotal	80912.6	72467.8	45318.5	279981.8	247382.6	91917.9	
Octopus Fishing	393.2	642.8	292.7	971.3	1599.1	653.1	±21%
"Others"	1033.5	1033.5	590.6	1896.6	1896.6	5877.1	±38%
Total	82339.3	74144.1	46201.8	282849.7	250878.3	98448.1	±5%

Table 3. Estimated annual (FY 86) inshore fishing participation, effort, and harvest for nighttime period for all fishing methods.

	No. of Persons	No. of Gear Units	No. of Trips	Person-Hours	Gear-Hours	Catch (Kg)	Coeff. of Var
Hook and Line	15038.0	15506.9	6104.9	46209.0	47639.4	9391.3	±7%
Cast Net	141.4	103.6	103.6	212.2	155.4	114.4	±35%
Gill Net	5077.8	2197.7	2120.5	12578.1	5418.7	8160.0	±11%
Spearfishing	5353.6	5278.7	1859.3	13296.0	13103.5	9847.7	±12%
Drag Net	2664.9	390.6	390.6	7457.5	1080.0	2478.3	±27%
SubTotal	28275.7	23477.5	10578.9	79752.8	67397.0	29991.7	
Octopus Fishing	117.4	14.7	7.3	214.8	26.9	11.0	±100%
"Others"	1488.9	1488.9	1297.6	4903.7	4903.7	7621.0	±20%
Total	29882.0	24981.1	11883.8	84871.3	72327.6	37623.7	±5%

net fishing method in terms of catch was gill netting with an estimated harvest of 31.7 m.t. or a mean catch rate of 1.32 Kg/gear-hour. Again this year, surround netting yielded the highest mean catch rate of all methods at 4.26 Kg/gear-hour but produced only 6634 Kg of fish. These numbers for surround netting are quite a bit lower than those reported for FY 85. This may be due to a slight decrease in observed participants for FY 86. In FY 85, an estimated 3880 people participated in this method as compared to 2141 people for FY 86. Drag netting also contributed to the estimated catch by yielding approximately 2784 Kg with a large majority being harvested at night (2478 Kg, Table 3).

The goatfish (Family Mullidae) comprised almost a third of the total finfish harvest at 30.2% (Table 4). This may be attributed to high levels of seasonal recruits of goatfish for FY 86. Other species that comprised a major portion of the finfish harvest were surgeonfish (Family Acanthuridae) at 16.5%, triggerfish (Family Balistidae) at 12.8%, snappers (Family Lutjanidae) at 5.4%, and both rabbitfish (Family Siganidae) and emperors (Family Lethrinidae) at 4.2% (Table 4).

The seasonal harvest of certain juvenile fishes is widely anticipated by local fishers. The FY 85 harvest was marked by small numbers of juvenile goat fish (tiao) especially during March and April; juvenile rabbitfish (manahac) during April, May and June; and juvenile jacks (e'e') primarily during July and August. In addition, harvest of atulai (*Selar crumenopthalmus*) was made throughout an unusually long season. Runs started in mid-May and remained beyond the end of the fiscal year.

In general, the harvests of tiao and e'e' are fairly well represented within the estimates given in Tables 1-3. However, the take of manahac and atulai are not well represented due to the highly sporadic nature of the harvest and the randomness of our present survey methods. Making accurate estimates for such harvest would require intensive survey effort during the time periods in which these fish are exploited. The seasonal occurrence of juvenile recruitment of *Siganus spinus* and *S. argentius* creates intense fishing for a very short period of time. The effort and catch are determined separate from the inshore harvest due to the sporadic nature of this fishery and the short season. Catch and effort data was collected daily during the month-long season and added to the inshore data expansion. Cast nets, gill nets and seines were used to harvest an unusually low 3.8 m.t. of juvenile rabbitfish.

The sporadic nature of atulai fishing required separate analysis from the participation data collected during regular participation surveys. The length of the season was determined by the first participation record and the last. The fishable number of days during that period were determined by the ratio of participated days to the number of survey days each month. This ratio was applied to the number of days in each month within the determined season. The number of fishable days was then multiplied by the average catch rate to determine the harvest. This method was applied only to net harvesting of atulai because harvest estimates by hook and line are included in the annual estimates. The estimated harvest for atulai was about 31 m.t. for FY 86.

In addition to finfish, a significant amount of other organisms were harvested from the reefs throughout the year. The estimated gaff and hook catch amounted to a very low 61.4 Kg and was totally comprised of octopus which was harvested at the rate of 0.41 Kg/gear-hour. Beyond this, "other methods", such as gleaning, produced an estimated 13.5 m.t. of various crustaceans, gastropods, bivalves, echinoderms and algae with a catch rate of 1.98 Kg/person-hour of fishing effort.

Table 4. Species composition of Guam's estimated daytime and nighttime inshore harvest for FY 86. The percentages do not include the seasonal harvest of juvenile rabbitfish (manahac) and bigeye scad (atulai).

Family	% of Finfish Harvest	% of Total Harvest	Weight (Kg)
Fin Fish			
Mullidae (goatfish)	30.2	26.8	36534.5
Acanthuridae (surgeonfish)	16.5	14.7	19947.4
Balistidae (triggerfish)	12.8	11.4	15449.4
Lutjanidae (snappers)	5.4	4.8	6534.9
Siganidae (rabbitfish)	4.2	3.7	5097.4
Lethrinidae (emperors)	4.2	3.7	5087.3
Sphyraenidae (barracudas)	4.1	3.7	5004.7
Carangidae (jacks)	3.8	3.4	4611.7
Scaridae (parrotfish)	3.2	2.8	3875.9
Holocentridae (squirrelfish)	3.1	2.8	3784.9
Mugilidae (mullets)	2.2	1.9	2603.4
Kyphosidae (rudderfish)	2.0	1.8	2401.3
Gerreidae (mojarras)	1.2	1.1	1431.1
Labridae (wrasses)	0.8	0.7	908.5
Other	6.3	5.5	7542.8
SubTotal	100.0	88.8	120815.2
Non Fin Fish			
Sea urchins	---	1.8	2461.6
Octopus	---	1.5	2004.4
Trochus	---	1.2	1608.0
Lobster	---	0.5	678.4
Other	---	6.2	8504.1
TOTAL	100.0	100.0	136071.7

RECOMMENDATION

The addition of a computer system and appropriate software packages have greatly reduced the amount of time needed to compile and analyze Guam's inshore fisheries survey data. Because of this, more effort has been spent to continually upgrade our data collection procedures to ensure statistical reliability. Since the inshore fisheries survey provides information important for management and planning, it is recommended that this job be continued. Also, provided there is adequate personnel, reinstituting the aerial surveys of uncensused areas around Guam is highly recommended in order to update island-wide participation estimates.

Report prepared by: Robert D. Rinehart

PROJECT TITLE: Fish Weir Report

PERIOD COVERED: October 1, 1985 to September 30, 1986

There were six licensed weirs in the Merizo/Cocos Lagoon area during FY 86. A harvest of 4,247.5 kg during a combined 1143 weir-days of opreration was reported in monthly catch reports for five of the sites. One license holder failed to maintain an operational weir during most, if not all of the year, and failed to complete catch reports for a few of the months. The harvest from that site, if any, is believed to be insignificant. Some theft was reported from Sites 4 and 6. To estimate the amount of catch stolen, the average daily catch rate was calculated for each month in which the theft occurred (not including the days the catch was stolen). The average daily catch value was then multiplied by the number of days the catch was stolen. This yields an estimate of 118.4 kg of stolen fish, increasing the estimated total harvest to 4,365.9 kg.

As in previous years, the weir harvest was dominated by carangids (29.2%), lethrinids/lutjanids (25.5%), mullids (13.7%) and mugilids (9.0%) (Table 1).

The average harvest per day varied from 3.34 kg at Site 5 to 4.45 kg at Site 2. The mean daily catch rate for all six sites ranged from 2.33 kg/day in September to 5.43 kg/day in October with an overall mean of 3.72 kg/day for the entire year.* The six weirs were operated an average of 190.5 days. Sites 1 and 5 were operated the greatest amount of time (329 and 351 days, respectively) and Site 3 was operated the least amount of time (0 days reported, Table 2).

The estimated catch of 4,365.9 kg is 34% lower than that of FY 84 and is 48% below the record level of 8,413 kg estimated for FY 80.** The drop in the harvest was due entirely to a 31% drop in the catch rate, since the combined number of operational weir-days (1143) remained essentially unchanged (1137 in FY 85). This is more than double the drop in catch rate that occurred between FY 84 and FY 85. This was the second straight year in which the harvest dropped by more than 34%.

Report prepared by: Robert F. Myers

*Excluding days in which the catch was reported stolen.

**Excluding the estimated catch for *Selar crumenophthalmus*.

Table 1. Composition of the reported fish weir catch for FY 86.

Fish Family	Reported Catch (Kg)	Percent (%) of Reported Total Catch
Acanthuridae (Surgeonfishes, Kicho)	44.3	1.0
Carangidae* (Jacks, Tarakito)	1,237.6	29.2
Carangidae *S. crumenopthalmus* (Atulai)	57.1	1.3
Leiognathidae/Gerreidae (Soapys, Guaguas)	259.4	6.1
Lethrinidae/Lutjanidae (Emperors, Snappers, Mafute)	1,081.2	25.5
Mugilidae (Mullets, Laiguan)	383.4	9.0
Mullidae (Goatfishes, Salmoneti)	580.3	13.7
Serranidae (Groupers, Gadao)	50.8	1.2
Siganidae (Rabbitfishes, Sesjun)	73.4	1.7
Others	480.0	11.3
TOTAL	4,247.5	100.0

*Excluding *Selar crumenopthalmus*

Table 2. Average daily catch rates (Kg/day) for the licensed fish weirs operating in the Merizo/Cocos Lagoon region during FY 86[1]. No catch was reported from site 3 which was not operated for most, if not all of the year.

Site	Location	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	FY 86	No. of Days in Operation
1	Tomogi-Afgo	4.29	3.22	2.47	3.00	3.26	4.27	5.97	4.62	5.20	5.00	1.29		3.92	329
2	Sagua dano - Hasta	8.20	3.94					3.94	4.14	3.00				4.45	82
4	Ton Vicente - Sagua Usao			3.65 (4.11)	6.11 (7.42)	4.54 (4.84)	6.03 (7.67)	4.35 (4.58)	3.88 (4.36)	2.69 (2.79)	4.60 (4.99)	5.44	2.74 (3.10)	4.12 (4.57)	174 (157)
5	Aba - Aang	3.79	2.46	3.60	2.62	2.40	2.82	3.49	3.07	5.28	4.43	4.54	2.01	3.34	351
6	Sagua Usao - Mapua			4.67	4.61	3.15 (3.65)	4.01	2.67 (2.99)	2.70 (3.30)	2.03 (2.29)	4.21 (4.65)	8.73	2.23	3.41 (3.65)	207 (193)
	All Sites[2]	5.43	3.21	3.60 (3.71)	4.09 (4.41)	3.34 (3.54)	4.28 (4.69)	4.08 (4.19)	3.68 (3.90)	3.64 (3.71)	4.56 (4.77)	5.00	2.33 (2.45)	3.72 (3.82)	1143 (1112)

[1]Numbers in parentheses are based only on days in which the catch was not stolen.

[2]Means for all six sites combined are based on an average of each site's monthly mean.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 3

JOB TITLE: Fisheries Data Processing

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

During FY 86, offshore and inshore fisheries survey data were entered onto computer files and edited for completeness and accuracy. The offshore data base for this fiscal year contains 1822 records and the "inshore-participation" and "inshore-catch" data bases contain 2354 and 1615 records, respectively. The primary software packages used for data analysis were the Guam Offshore Expansion System (GOES) and the "Guam Tournament" module for the offshore fisheries survey data and the Guam Inshore Expansion System (GIES) for the inshore fisheries survey data.

A data base was established for Job 8, "Studies of Recreationally Important Reef Fish", and research data collected on Lethrinid species were entered. Various statistical software packages were used to analyze this data.

BACKGROUND

Guam's Division of Aquatic and Wildlife Resources (DAWR) has been collecting fisheries information for the past ten years and, as a result, an enormous amount of fisheries management data has been accumulated. Computers have been used over the past four years by DAWR to store and analyze this data. DAWR personnel, working closely with the National Marine Fisheries Service, have developed and purchased programs for analyzing the Division's offshore and inshore fisheries survey data.

In FY 83, a program entitled the Guam Offshore Expansion System (GOES) was developed based on the current practices of offshore data analysis and, in FY 85, a Guam Inshore Expansion System (GIES) was completed and tested for errors. Since this time, all data collected for the offshore and inshore fisheries surveys have been analyzed by the use of these two programs.

Job 3, Fisheries Data Processing, has continued to improve over the past fiscal year because of increased computer systems training for DAWR staff biologists and improved hardware and software components. Since its beginning, Job 3 has been jointly funded by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Western Pacific Regional Fisheries Management Council.

OBJECTIVES

The objectives of Job 3 for the past fiscal year were as follows:

1. Computerize the DAWR's offshore and inshore marine fisheries data and transfer the finalized fisheries data files and reports to NMFS personnel in Honolulu, Hawaii for regional application.

2. Provide technical assistance to DAWR staff biologists in the form of efficient statistical analysis and report generation.

3. Continue training of DAWR staff biologists on the proper use of the present computer hardware and software systems.

PROCEDURES

Guam's offshore fisheries survey data is analyzed by a system of computer programs known as the GOES. This programming package is a 5-step system that summarizes, sorts, and statistically expands the survey data to produce monthly and annual catch, effort, and species composition estimates. Two proportionality constants and a "total participation boat count" are calculated and manually input into the expansion module by the user. Reports are generated by the GOES that give a breakdown of the estimated offshore harvest by gear type on a monthly and annual basis. Also, an estimated harvest by species is generated for each gear type with a corresponding percentage of the total catch for that gear type. A second program, known as the "Guam Tournament" module, is an extension of the GOES that separately analyzes the Guam International Fishing Derby (GIFD) data and then adds the results of this analysis directly to the offshore fisheries harvest estimate.

Guam's inshore fisheries survey data is analyzed by a programming package known as the GIES. The GIES is a 4-step system that relies on two sets of survey data to determine an annual inshore estimated harvest. These two sets of data are referred to as "inshore-participation" and inshore-catch". "Inshore-participation" data consists of fishermen and gear counts obtained by staff biologists when driving around the island and making observations on fishing activity within the fringing reef. "Inshore-catch" data is obtained by fishermen-intercept interviews that usually occur within a predetermined survey region. This data consists of a total catch and catch by species for each interview. Because of the apparent differences in participation and catch-per-unit-effort (CPUE) of the various gear types between daytime and nighttime fishing, a fisheries survey is conducted during each of these two time periods and the data are analyzed separately. Also, data is collected during the seasonal harvest of juvenile rabbitfish (*Siganus spp.*) and bigeye scad (*Selar crumenapthalmus*), but, because of the dissimilarities between the seasonal fisheries and the routine inshore fisheries, the two are analyzed separately.

RESULTS

Offshore Fisheries Survey Data Base Management

The DAWR's offshore fisheries survey data for FY 86 were entered onto computer files and edited for completeness and accuracy. The total number of records for the FY 86 offshore data base are 1822. This brings the total number of historical and current offshore records to 14,790. The FY 86 GIFD data were entered onto the data base and the total number of records for this year's fishing derby are 311. This brings the total number of fishing derby records to 1986.

Based upon the expansion calculated by the GOES and "Guam Tournament" module, the estimated island-wide offshore harvest for FY 86, including the GIFD results, is about 261 metric tons. For more detailed information, see Job 1, "Offshore Fisheries Survey".

Inshore Fisheries Survey Data Base Management

The FY 86 DAWR inshore fisheries survey data were entered onto two data bases. The "inshore-catch" and the "inshore-participation" data bases for this fiscal year contain 1615 and 2354 records, respectively. This brings the total number of historical and current "inshore-catch" records to 19,062 and the "inshore-participation" records to 12,648.

Based upon the expansion calculated by the GIES, the total FY 86 harvest estimate for Guam's inshore fisheries, combining day fishing, night fishing, and seasonal fishing, is approximately 171metric tons. For more detailed information, see Job 2, "Inshore Fisheries Survey".

Other Fisheries Data Bases

The collection of reef fish data used for Job 8, "Studies of Recreationally Important Reef Fish", has continued over the past fiscal year to obtain information on emperors (*Lethrinus spp.*). Therefore, a data base was established for the storage and dissemination of this data and the total number of records contained in this data base is 1687.

RECOMMENDATION

Data processing has become a valuable asset to the many research projects currently undertaken at DAWR. Data storage and retrieval, data analysis, and report generation has improved greatly since the installation of a computer system and, because of this, continuation of this job is recommended.

Report prepared by: Robert D. Rinehart

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 10

JOB TITLE: Studies of Recreationally Important Offshore Pelagic and Demersal Fish

PERIOD COVERED: October 1, 1984 to September 30, 1986.

OBJECTIVES

To obtain sufficient information on the biology and life history of selected offshore species to permit evaluation of the need for stock management.

RESULTS

This job was inactive during this segment due to the shortage of staff.

RECOMMENDATIONS

This job should be implemented in Segment 23 if adequate manpower is available.

Report prepared by: Robert D. Rinehart

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R
SUB-PROJECT: F
STUDY NO.: 1
JOB NO.: 11

JOB TITLE: Biomass and Stock Assessment

PERIOD COVERED: October 1, 1985 to September 30, 1986.

BACKGROUND

Effective management of fisheries resources requires an understanding of the effects of fishing pressure on the stocks of target species as well as an understanding of their population dynamics, life histories, ecology, and limits of distribution within the environment. The harvest of most of Guam's reef fish species is adequately known, however, little quantitative information on their standing stocks is available. Limited surveys have been conducted a number of years ago, but none of these was island-wide in scope, non sampled a complete range of reef zones or habitats, and no attempt has been made to obtain quantitative or adequate qualitative information on populations below the practical limits of scuba diving. As the fishing pressure on Guam's recreational reef fishes continues to increase, it is increasingly necessary to obtain quantitative as well as qualitative information on the standing stocks of these fishes and those they interact with in a representative range of reef zones and habitats and, if possible, in relatively unexploited as well as highly exploited areas.

OBJECTIVE

Assess and monitor the biomass of Guam's important reef fish species within selected sites and reef zones by means of visual transects.

PROCEDURES

Within each reef zone at each site, the following three types of counts of reef fishes are tentatively planned: (1) visual transects consisting of timed 10 minute replicate counts of all roving species within 5 m of the observer, (2) 5 minute replicate counts of all territorial and non-roving species, and (3) counts to the limit of "recognition visibility" of all individuals of "observer shy" or rare species. It should be noted that several new methodologies for visual counts made by scuba divers have appeared in the literature in recent years (eg. Bohnsack and Bannerot 1985); the potential of a number of these is being investigated and, depending on the results of field trials, one or more of these may be selected over one or more of the above methods. Other methods that may yield valuable information beyond the reach of visual transects made by scuba divers are also being investigated. These include the use of a remote video camera (operated by the University of Guam Marine Laboratory; this method may eliminate the bias caused by observer-shy species leaving the area of a scuba diver) and a deep-diving submersible. Both of these methods will enable certain

kinds of counts to be made to the lower depth limit of the species being investigated (Thresher and Colin, 1986).

RESULTS

Literature on reef fish community structure and survey methods was reviewed. Several study sites around the island have been proposed. Transect locations for most of the reef flat and some of the shallow lagoon and seaward reef sites have been selected. Preliminary species lists have been made for some of the habitats within these sites. Resignations within the staff before the end of FY 86 required that this project be postponed until sufficient personnel are hired and trained.

RECOMMENDATIONS

It is recommended that this project remain active at a low level until sufficient personnel are hired and trained to perform the necessary work.

LITERATURE CITED

Bohnsack, J.A., and S.P. Bannerot. 1986. A Stationary Visual Census Technique for Quantitatively Assessing Community Structure of Coral Reef Fishes. NOAA Technical Report NMFS 41, 15 pp.

Thresher, R. E., and P. L. Colin. 1986. Trophic structure, diversity and abundance of fishes of the deep reef (30-300 m) at Enewetak, Marshall Islands. Bull. Mar. Sci. 38(1): 253-272.

Report prepared by: Robert F. Myers

GUAM FISHERIES DEVELOPMENT
PROJECTS F-2-D
Federal Aid in Sport Fish Restoration Act

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam **PROJECT NO.:** F-2-D-6

JOB TITLE: Construction of Fish Aggregating Devices.

PERIOD COVERED: April 1 to September 30, 1986.

BACKGROUND

Low nutrient levels in offshore tropical waters result in correspondingly low productivity and pelagic fishes being thinly scattered over wide areas. Several problems face fishermen in the tropics including considerable time wasted searching for pelagic fishes offshore, the inability to reach pelagic fishes in unsheltered rough waters, and low concentrations of both pelagic and reef fish in any particular area. Various types of rafts in Malta, Japan, and the Philippines have been used for centuries to aggregate coastal pelagic fishes and improve catches. These rafts capitalize on the behavior of certain pelagic fish to aggregate under floating objects. One likely explanation is that small fishes congregate around the floating object for protection and these in turn attract larger predatory species. Other possible explanations are that some pelagic fishes may use the objects as cleaner stations, spawning substrates, or points of reference in an otherwise rather featureless environment.

In 1977, the National Marine Fisheries Service in Hawaii experimented with "permanently" moored offshore fish aggregating devices (FADS) to determine if it was possible to attract, aggregate and hold pelagic fish schools in the FADs vicinity and thereby improve catch rates. Since the initial Hawaii Project, several Pacific islands including Guam have conducted similar offshore FAD programs. Construction of offshore FADs on Guam began in 1979 as a result of a $21,500 grant from the Pacific Tuna Development Foundation, and was later continued as part of the Dingell-Johnson Fisheries Development program. This project was expected to enhance the quality of the recreational fishing experience available on Guam through increased catches and reductions in the time lost searching for fishes. Around the island of Guam and its associated shallow banks, common sportfishes expected to be attracted by FADs include migratory tunas, dolphinfish, billfish and rainbow runners, as well as juveniles of a variety of resident reef fishes.

A General Permit good for 10 years (until April 1992) was obtained from the U.S. Army Corps of Enginers, eliminating the need for repeated permit renewal. Detailed descriptions of the FAD designs utilized on Guam were given in DAWR's FY 80 Annual Report. Complete summaries of the results of this program were given in the FY 83 and FY 85 Annual Reports.

By the end of FY 84 all buoys had been lost primarily due to problems with the mooring system design and materials.

Observation dives made beneath the buoys provide information on the species and behavioral characteristics of fish associated with the FADS. Over twenty fish species have

been observed beneath the FADs and these comprised seven juvenile or young adult reef species, five pelagic baitfishes and seven predators, four of which were recreationally important species of troll fish. Other recreationally important species have been caught within the vicinity (1 mile) of the FADs. Since then numerous design improvements have been made.

Data on buoy fishing success was collected primarily in two ways: by handing out self-addressed FAD catch cards and conducting angler interviews. Initially, these methods provided only sparse data on fishing success but became much more productive during FY 82. Limited data indicate that Guam's FADs effectively increased catches, although longevity was a problem.

Only one FAD remained on-site between 1 October 1982 and 8 April 1983. Data from random samples of anglers returning to the Agana Boat Basin during that period showed that the FAD was used by a majority (60%) of those interviewed. The overall catch rate for those sampled (6.5 Kg/boat-hour) was very similar to that for the average troller who used the Agana Boat Basin (6.7 Kg/boat-hour) during FY 83. However, for those who fished the FAD an increase in catch rate of approximately 60% was realized (5.2 vs. 8.4 Kg/boat-hour) for the time spent near the FAD compared with fishing done away from it in other nearshore waters. It was recommended that the project should be continued once sufficient improvements in the mooring design were made.

OBJECTIVE

Fabricate, deploy, and maintain a system of Fish Aggregating Devices (FADs) with projected life expectancies of at least two years in the nearshore waters off Guam.

PROCEDURES

Material on the results of recent FAD projects as well as designs used throughout the world has been gathered. Appropriate government agencies have been contact regarding changes in the existing Army Corps of Engineers permit as well as clearances from the U. S. Coast Guard and Navy. Sources of materials have been identified.

RESULTS

The design of the proposed FADs and their mooring systems will closely follow designs currently being deployed by the state of Hawaii's Division of Aquatic Resources and recommended in SPC Handbook No. 24 (1984), "Design Improvements To Fish Aggregating Device (FAD) Mooring Systems In General Use In Pacific Island Countries". The improved mooring system has shown a greater life expectancy than previous mooring designs. We have requested that the Army Corps of Engineers amend the existing permit (PODCO-O 82-3) to accommodate certain design changes and don't expect any problems. We have also contacted COMNAVMAR, the U.S. Coast Guard, and the National Marine Fisheries Service regarding our planned redeployment, and do not anticipate any opposition. The Division is currently:

1. In the process of acquiring six Navy surplus buoys of suitable size, shape, and condition to serve as FADs.

2. Locating sources of FAD mooring system components.

3. Preparing a bid proposal for the assembly and deployment of FADs.

We expect to acquire the six Navy surplus buoys by the end of January 1987. We are planning an initial deployment of five of these at sites previously used by mid-1987. The sixth will be held in reserve. Shortly after deployment we will initiate the construction of five to six additional FADs, and either redeploy them at some of the five existing sites or choose new sites, depending on the rate of attrition of the initially deployed FADs.

RECOMMENDATION

The results of the FY 79-84 FAD program have shown that FADs were effective in aggregating recreationally important pelagic game fishes at point locations in the nearshore waters of Guam. It has been demonstrated that FADs enhance overall catch rates and are strongly favored by the recreational fishing community. The DAWR thus feels that an FAD project should receive the highest priority and that a number of FADs should be deployed as soon as possible.

Report prepared by: Robert F. Myers

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam **PROJECT NO.:** F-2-D-7

JOB TITLE: Development of Small Boat Launching Facilities.

PERIOD COVERED: April 24, 1985 to September 30, 1986.

OBJECTIVES

Redesign and renovate existing public boat launching ramp located at Merizo, Guam.

RESULTS

This job was inactive during this segment. The renovation (repair and/or redesign) of the existing boat ramp was deemed by the Government of Guam Department of Public Works engineers to be impractical. Instead the engineers recommended the existing ramp be removed and a new one built in its place. Because the cost of the new ramp was beyond the funds available the Merizo residents opted to abandon this project. An alternate plan to repair and extend the existing boat pier (located adjacent to the launch ramp) is currently in the developmental stages. Construction activity is projected to begin during Fiscal Year 1987.

RECOMMENDATIONS

Amend Progect Agreement to reflect the alternate plan to repair and extend the existing boat pier. This project should be continued through the design and construction phases until the pier is open for public use.

Report prepared by: Gretchen R. Grimm

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam **PROJECT NO.:** F-2-D-8

JOB TITLE: Development of Inshore Fishing Access Facilities.

PERIOD COVERED: April 24, 1985 to September 30, 1986.

OBJECTIVES

Develop and initiate construction of inshore fishing access facilities (i.e. fishing pier or platform) on the windward shoreline of Guam with alternate sites on the leeward side.

RESULTS

Togcha Bay on the windward side of Guam was selected as the site for placement of a fishing pier or platform. The aid of the Government of Guam, Department of Public Works Engineering Department was enlisted to solicit interest from qualified architectural and engineering firms to design a structure. Additionally, a search was initiated to obtain information on fishing piers and/or platforms. Specific information is needed on design, construction and public usage of this type of facility.

RECOMMENDATIONS

This project should be continued during fiscal year 1987. A literature review should be continued to provide references necessary for formulating a useful design. An environmental impact statement should be prepared on the proposed site. A firm qualified in marine engineering should be contracted and construction on the structure begun.

Report prepared by: Gretchen R. Grimm

AQUACULTURE
Funding Source: National Marine Fisheries Service
(P.L. 88-309)
Government of Guam

PROJECT TITLE: Development of Tropical Polyculture Fish Farming

PERIOD COVERED: October 1, 1985 through September 30, 1986.

OVERVIEW

During FY 86, the Division of Aquatic and Wildlife Resources (DAWR) continued to work primarily with the Thai catfish, *Pangasius sutchi*. Fifty new catfish were placed into a 0.1 hectare pond and fed an improved diet in an effort to obtain fully mature eggs.

In addition, DAWR personnel provided a limited amount of technical assistance to the aquaculture community and the general public of Guam (Table 1). However, the primary role of providing technical and field assistance to local aquaculture farmers has been assumed by the University of Guam Extension Service.

A "Master Aquaculture Permit Application" was developed for Public Law No. 18-18. The designed permit application outlines a step-by-step procedure for starting an aquaculture venture on Guam.

Table 1. People given technical aquaculture assistance from October 1, 1985 to September 30, 1986*

NAME	LOCATION	AFFILIATION	INTEREST
Galeai P. Poumele	American Samoa	Government	General Aquaculture
Edward W. Eckhoff	Woodland Calif.	Reef Falls Ent.	General Aquaculture
Joselin Gogue	Mangilao	UOG Student	Class Project
Frank Pangelinan	Yigo	Private	Tilapia and Guppies
Pat Salas	Mangilao	Private	Tilapia and Guppies
Junior Cruz	Baza Gardens	Private	Tilapia and Guppies
Frank Jackson	Barrigada	Private	Guppies
Mary Ford	Yigo	Private	Guppies
David Torres Cruz	Tamuning	Private	Aquaculture Project at Piti
Manuel Chargulaf	Tamuning	Private	Technical advice for aquaculture & EIS write-up
Charles J. Taylor	Yigo	Private	Tilapia, catfish and freshwater prawns
Jesus Cruz	Agat	Private	Tilapia fish kill in pond
Albert Aberto	Mangilao	Private	Guppies and aquatic plants
Pete Blas	Mangilao	Private	Guppies and aquatic plants
Joseph D. Chargulaf	Inarajan	School Project	Guppies

*In addition to those listed, numerous local aquaculturists contacted the DAWR during the fiscal year for technical assistance covering a wide range of topics.

ARTIFICIAL REPRODUCTION OF THE THAI CATFISH, *PANGASIUS SUTCHI*

Fifty catfish, *Pangesius sutchi*, fry were shipped to Guam in September 1985, from Taiwan. The female brooders in their first year of life did not reach sexual maturity during the 1986 breeding season. No artificial reproduction trials were conducted since the eggs did not reach full oogenesis. The male brooders usually had abundant milt throughout the project period. The catfish were kept in a small earthen pond and fed a specially formulated diet.

OBJECTIVES

1. To obtain oogenesis and egg release in the Thai catfish, *Pangasius sutchi*, at Guam.

2. To develop a viable methodology for artificially reproducing *P. sutchi* and for rearing its hatchlings to the fingerling stage at Guam.

PROCEDURES

A 0.1 hectare, triangular-shaped pond with a screened six-inch inflow pipe was used for the project. The pond was drained and all of the tilapia (*Oreochromis spp.*) were killed using rotenone. A composite soil sample was taken that indicated a soil pH of 7.7. The pond was filled with water to an average depth of one meter one month before stocking with the *P. sutchi*. After the initial stocking of the catfish brooders, the pond was flushed during the first and third weeks of each month with a submersible pump attached to a four inch pipe. Following each flushing, the pond was refilled to its normal level as soon as practical.

On June 11, 1986, fifty *P. sutchi* (mean weight, .52 kg/fish) were stocked in the pond . While the fish were being stocked, each brooder was examined for the state of reproductive maturation by using a combination of bending the fish and gently rubbing its abdomen near the vent, and/or by physically trying to suck out some of the eggs using a plastic catheter. Thirteen of the male brooders had milt present indicating that some of them had testes that reached full maturation. The exact sex ratio was unknown because there were no primary external characters on the fish. Three female brooders were selected and dissected prior to stocking and no ovarian development was noticed.

A special diet was formulated and fed to the brooders five times a week. From June 12 to August 21 and August 21 to Sept. 30, 1986, the fish were fed at a rate based on 2% and 4% of their total biomass, respectively. The diet consisted of soybeans (36%), chum tuna (36%), yellow corn meal (6.75%), winter wheat (6.75%), whole barley (6.75%), brown rice (6.75%), *Spirulina* (.18%), cod liver oil (.26%), Vitamin E (.18%) and pelbon-feed grade bentonite (.38%) (Table 2). The size of the soybeans was reduced in a blender, steamed for 10 minutes, and heated in the oven at 105°C for 50 minutes. During the steaming, the moisture content was increased by 11%. After a complete drying of the ground soybeans, all the grains were finely ground in a Magic Mill III flour mill. After the grains were milled, the dry ingredients were all weighed on a triple beam balance, put into a metal basin for mixing and placed in a plastic bag. The freshly processed feed was placed into a styrofoam chest with blue ice to keep the temperature down during transport to the pond. Just prior to fish feeding, the cod liver oil and vitamin E were mixed in with the freshly thawed tuna. The flour and tuna were combined, mixed, and kneaded to a dough-

like consistency. The feed was formed into small balls and fed to the fish usually during the mid-afternoon. Cloud cover, wind, air temperature, water temperature, water color, water surface, water level, fish activity, and other general observations were made at every feeding.

RESULTS

After the fish were stocked on June 11, all of the brooders were examined between August 18-20, 1986 to check for reproductive maturation. This was done because four brooders were recaptured outside the pond following heavy rains and flooding that occurred on August 1, 1986. To completely examine all of the fish, the pond was completely drained and seined, and the fish counted and weighed. The information was needed for determining the new feeding rate for the brooders because six brooders had been lost. The forty-four fish had a mean weight of .71 kg. Of the male brooders examined, 28 had white milt present. The other fish showed no enlargement of the ventral region or reddening of the vent. No eggs were noticed while handling and observing the female brooders indicating that sexual maturity was not achieved during the first year of life.

During the daily afternoon visits to the pond (usually around 3pm), the air and water temperatures were taken and recorded. The air temperature had a range of 24.0-38.5°C with a mean of 30.0°C and the water temperature had a range of 25.0-36.0°C with a mean of 32.6°C. Two periods of cloudiness and rain were observed from June 11-30, 1986 and July 31-August 26, 1986. The remainder of the days were mostly partly cloudy with a slight breeze present. The predominate color of the water during the project was brown-green. Because the pond was small and protected by large trees on one side, the water surface was usually smooth. The water level flucuated in the pond, and new freshwater was added as soon a possible after the level was found to be low. Sometimes during the feeding period, some catfish could be seen surfacing for air or swimming near the water surface. Filamentous green algae and the "waterweed", *Hydrilla verticillata*, were observed along the pond edge and became troublesome by the end of September.

DISCUSSION

The project was initiated this year with a new batch of *P. sutchi* shipped in September 1985 from Taiwan to hopefully achieve successful egg oogenesis. In the past, eggs of the female brooders always remained immature and white without incorporation of the yolk material into the eggs. The first attempts with hormones to induce oogenesis and ovulation were unsuccessful (Kruckenberg, 1981, Kruckenberg, 1982). Later, the diet and environmental conditions were varied in hopes of achieving egg oogenesis again without success (Kruckenberg, 1984; Kruckenberg, 1985). After attempting to achieve egg oogenesis a number of times, it was decided that there were some other factors beyond our control affecting the brooders. These have continually made it impossible to achieve complete maturation of the eggs even when we changed their environment and diet (Kruckenberg, 1985).

Hopefully, with the new brooders, many of the factors that could have inhibited successful egg oogenesis in the past will be held to a minimum to insure the production of viable eggs. The pond environment should provide similar conditions to that of the riverine habitat from where they originated. The pond with natural plankton and plenty of space should provide the proper amount of turbidity and enough area to prevent the stressful conditions with clear water and crowding that the first group of brooders encountered in the cement raceway at the DAWR. The water quality should be good because it was pumped up from a clean source (the Ajayan River). Water quality could be reduced if chlorine is added to the river or the breakdown of uneaten food causes low oxygen levels to occur in the pond

water. The nutritional needs of the fish should be met because they are being fed a complete diet that is freshly prepared for each feeding. In addition, the natural food organisms in the pond like the organic matrix on the pond bottom, algae and vascular aquatic plants should supplement their diet providing other nutritive benefits especially the vitamins needed for successful oogenesis of the eggs. In the past, a "repressive factor" (Swingle, 1956) may have been present in the water preventing the complete egg oogenesis within the brooder catfish. It appears to be a hormone-like excretion or secretion from the fish directly into the pond water that prevents or retards reproduction in riverine fishes placed in ponds. This may have been present in the water with the first group of fish making them unable to develop mature eggs. If the repressive factor is present in the water, it will hopefully be removed by the periodic flushings of the pond twice a month.

RECOMMENDATIONS

Because of a lack of mature eggs and successful oogenesis, the *P. sutchi* should be left in the pond and checked periodically during the next breeding season, especially July and August, for successful oogenesis.

LITERATURE CITED

Kruckenberg, Wayne L. 1981. Annual Report Fiscal Year 1981. Aquatic & Wildlife Resources, Department of Agriculture. pp. 99-102.

Kruckenberg, Wayne L. 1982. Annual Report Fiscal Year 1982. Aquatic & Wildlife Resources, Department of Agriculture. pp. 156-168.

Kruckenberg, Wayne L. 1984. Annual Report Fiscal Year 1984. Aquatic & Wildlife Resources, Department of Agriculture. pp. 87-99.

Kruckenberg, Wayne L. 1985. Annual Report Fiscal Year 1985. Aquatic & Wildlife Resources, Department of Agriculture.

Swingle, H.S. 1956. A Repressive Factor Controlling Reproduction in Fishes. Proceedings of the Eighth Pacific Science Congress. Oceanography and Zoology. National Research Council of the Philippines, University of the Philippines, Diliman, Quezon City. Vol. III A. p. 865-871.

Report prepared by: Wayne Kruckenberg

GUAM WILDLIFE INVESTIGATIONS
PROJECT FW-2R-23
Federal Aid in Wildlife Restoration Act

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-1
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Determination of Current Population Size and Distribution of Guam Deer.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

License sales dropped 7.2% during FY 1986 with 433 licenses sold throughout the year. Based on reported hunter participation of 79% and hunter success of 14.1%, an estimated 294 sportsmen hunted deer and harvested 41 animals during FY 1986. Hunter success and harvest was slightly lower than the 17.6% success and 52 deer harvested in FY 1985. An estimated 5,027 hunter days were spent pursuing deer in FY 1986, an increase of 119% over the FY 1985 level. It required more effort to harvest a deer in FY 1986, 122.6 days/deer, an increase of 178% over the FY 1985 level. The most popular deer hunting areas on island were Northwest Field (NWF), Naval Communication Area Master Station (NAVCAMS), and bow areas on Andersen Air Force Base (AAFB). Deer hunters also hunted the Cotal (Tarzan Falls), Anao, and Bolanos Territorial Conservation Reserves and private property. Population trend data obtained with spotlight counts indicated a significant ($P<0.002$) increase in deer numbers at AAFB and nonsignificant increases in deer ($P>0.20$) and water buffalo ($P>0.10$) numbers at the Naval Magazine (NAVMAG).

BACKGROUND

The Guam deer has been under investigation by the Division of Aquatic & Wildlife Resources since 1961. Its distribution, population trends and biology have been described by Wheeler (1979). Deer hunting statistics have been compiled since 1968 through hunter reporting procedures. The regular deer season is October 1 through December 31 with a bag limit of one antlered deer (buck only) per season per license holder exclusive of any special hunt harvest.

OBJECTIVES

To determine the current size and distribution of the deer population of Guam and to monitor population trends.

PROCEDURES

1. Continue monthly spotlight counts on AAFB at 21 per year, 4 per month in May - July and once in other months.

   a. Record number, age, sex and group composition.

   b. Statistically analyze count data and compare with past data to discern population trends.

2. Continue monthly spotlight counts on Naval Magazine with periodic spotlight counts in other areas.

3. Collect hunting statistics via a hunter questionnaire. Analyze hunting statistics for changes in hunter kill, effort, and hunting location.

4. Collect biological data from carcasses killed during regular season and special hunts or from incidental sources such as road kills or confiscated animals.

RESULTS

Deer Hunting Statistics

License sales decreased 7.2% during FY 1986 with 433 licenses sold throughout the year. All license holders were mailed a harvest questionnaire and responses were obtained from 115 persons (26.6%). Eighty-six percent of the respondents indicated they had hunted during FY 1986. Based on that percentage, an estimated 372 persons legally hunted game during the year. Hunters were asked to provide information on the amount of effort expended hunting, game harvested, and locations hunted and the following harvest statistics are based on the responses of 99 hunters that completed the questionnaire (Table 1).

Deer hunting is a popular sport on Guam with 79% of the responding hunters indicating they hunted deer during the FY 1986 season. Hunter success remained low at 14.1% in FY 1986, down slightly from 17.1% in FY 1985. The reported harvest came from Northwest Field (6), Urunao (3), NAVCAMS (1), and Bolanos Conservation Reserve (1). All 11 deer reported as harvested in the questionnaire were taken by shotgun. An average of 17.1 days were spent hunting deer by 78 hunters, more than double the 7.8 average reported in FY 1985.

Northwest Field remained the most popular area to hunt deer with 44% of Guam hunters hunting there. Thirty-four percent of all effort and 55% of the harvest came from Northwest Field. Bow areas on Andersen Air Force Base were also popular hunting spots but not as productive. Twenty-nine percent of all deer hunters expended 22% of the total hunting effort in bow areas on AAFB but did not harvest any deer. Cotal (Tarzan Falls), Anao, and Bolanos Territorial Conservation Reserves and other private property were also reported as hunted.

Most hunters (71%) reported they used the shotgun for deer hunting. This weapon was used in 72% of the effort and accounted for all the reported harvest. The bow was the next most popular weapon used by 29% of the reporting hunters for 22% of the hunting effort. Rifles and handguns were used by some hunters but were less popular. Deer hunters were asked to report on numbers of deer wounded and lost and crippling loss was very high in relation to the number of deer taken.

Table 1. Island-wide deer hunting statistics for FY 1986 as based on hunter responses to a harvest questionnaire.

a.	Total license sales for all game species	433
b.	Number of questionnaires sent out	433
c.	Number of hunter questionnaires returned	115
d.	Percent of queried license buyers that responded	26.6%
e.	Number of reporting license buyers that hunted any species	99
f.	Percent of license buyers that hunted any species	86.0%
g.	Estimated total number of legal hunters	372
h.	Number of reporting hunters (99) that hunted deer	78
i.	Percent of reporting hunters that hunted deer	79.0%
j.	Number of deer taken by 78 reporting deer hunters	11
k.	Hunter success	14.1%
l.	Estimated total number of legal deer hunters	294
m.	Estimated total legal deer take	41
n.	Hunter days expended by 78 reporting deer hunters	1333
o.	Average number of days spent per reporting deer hunter	17.1
p.	Estimated total number of days spent hunting deer	5027
q.	Number of days spent hunting per deer taken	122.6

Eight deer were reported as wounded and lost versus 11 reported as legally harvested, a crippling loss of 73% of the reported legal harvest.

Estimates of total hunter participation, effort, and harvest were derived from information provided on the hunter questionnaires. Based on questionnaire data, an estimated 294 hunters spent 5,027 days hunting and harvested 41 deer, an increase of 119% in effort and decrease of 21% in harvest over FY 1985 levels. Deer hunters expended an average of 122.6 days effort for each deer harvested in FY 1986, a large increase over the 44.1hunter days expended per deer harvested in FY 1985.

An accurate record of hunter effort and take from NAVCAMS military installation is summarized in Table 2. NAVCAMS received heavy hunting pressure this past season but not as high as the previous season. Total hunting effort during the 3-month season was 487.5 hunter 8-hr days, down 27% from the 666 reported in FY 1985. Two deer were harvested in FY 1986, identical to FY 1985. The effort required to harvest a deer at NAVCAMS decreased from FY 1985 levels. A total of 244 8-hr days were spent hunting deer per animal taken, a improvement of 27% over the 333 8-hr days expended per deer harvested in FY 1985. No information was provided on hunting effort and harvest at Northwest Field for FY 1986.

Spotlight Count Trends

Spotlight counts were conducted on AAFB (20) and NAVMAG (12) during FY 1986. The average number of deer seen per count increased on AAFB from 89.9 in FY 1985 to 111.9 in FY 1986 (Table 3). Numbers seen during the best 3 months for sighting deer, May-July, increased significantly over FY 1985 levels (Mann-Whitney U-Test, U = 140, n_1=12, n_2=12, P<0.002). The average number of deer seen per count also increased from 106.1 in May-July, 1985 to 139.4 in May-July, 1986 and the largest count increased from 132 (158 deer per 10 km) in 1985 to 170 (204 deer per 10 km) in 1986.

The decreasing trend observed in deer numbers on Naval Magazine may have eased as the average number of deer seen on monthly counts increased for the first time in 5 years. The average number of deer seen per count increased from 5.3 deer in FY 1985 to 6.5 deer in FY 1986 (Table 4). Although the increase was not statistically significant (Mann Whitney U-Test, U=76, n_1=12, n_2=11, P>0.20), the increase in numbers at least suggests that the population may be stabilizing at a low level. The largest count during FY 1986 also increased from 11 (5.0 deer per 10 km) in FY 1985 to 19 (8.6 deer per 10 km) in FY 1986.

Feral Asiatic Water Buffalo

Sightings of water buffalo (carabao) were made during the spotlight counts at NAVMAG. The average number of water buffalo seen per count increased from 26.2 in FY 1985 (Table 4) to 37.7 in FY 1986, a nonsignificant increase (Mann-Whitney U-Test, U=91.5, 0.20>P>0.10). The increase in carabao numbers coincides with the slight increase in deer numbers on the Naval Magazine. The largest number seen on a monthly count increased from 57 in FY 1985 to 78 in FY 1986. The increase in water buffalo numbers during FY 1986 may be a reversal of the declining trend that has occurred since 1982.

Table 2. Hunter effort and deer take based on official hunter logs from Naval Communication Area Master Station (NAVCAMS) and Northwest Field during FY 1986.

	October	November	December	Total	Effort/take
NAVCAMS					
No. hunter sorties	407	255	180	842	421
No. hunter 8-hr days	242.5	139.5	105.5	487.5	244
Deer taken	0	1	1	2	--
Northwest Field					
		No data provided this fiscal year			

Table 3. Composition of deer herd seen during spotlight counts at Andersen Air Force Base, during FY 1986.

		1985			1986									Summary Statistics			
	COUNT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL	AVE.	SD	CV-%
Unclassed buck	1	2	1	5		1	3	2	4	2	2	0	5	64	3.2	2.3	72
	2								3	2	6						
	3								3	0	3						
	4								4	7	9						
	Ave.	2.0	1.0	5.0		1.0	3.0	2.0	3.5	2.8	5.0	0.0	5.0				
Spike	1	1	3	1		1	1	1	1	3	0	0	0	24	1.2	1.4	117
	2								0	0	0						
	3								3	5	0						
	4								2	0	2						
	Ave.	1.0	3.0	1.0		1.0	1.0	1.0	1.5	2.0	0.5	0.0	0.0				
2pt	1	1	1	1		2	1	0	0	2	1	0	1	25	1.3	1.0	77
	2								2	1	4						
	3								1	1	3						
	4								1	1	1						
	Ave.	1.0	1.0	1.0		2.0	1.0	0.0	1.0	1.3	2.3	0.0	1.0				
3pt	1	4	8	8		3	1	6	6	5	5	0	7	122	6.1	2.8	46
	2								8	8	6						
	3								11	5	6						
	4								8	11	6						
	Ave.	4.0	8.0	8.0		3.0	1.0	6.0	8.3	7.3	5.8	0.0	7.0				
4pt	1	0	3	0		0	0	0	0	0	0	0	0	3	0.2	0.7	447
	2								0	0	0						
	3								0	0	0						
	4								0	0	0						
	Ave.	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Doe	1	36	35	36		23	12	48	87	71	68	17	74	1176	58.8	24.3	41
	2								78	66	72						
	3								96	64	63						
	4								81	75	74						
	Ave.	36.0	35.0	36.0		23.0	12.0	48.0	85.5	69.0	69.3	17.0	74.0				
Yearling	1	1	4	3		2	2	4	14	16	6	3	8	185	9.3	5.6	61
	2								11	14	12						
	3								16	16	12						
	4								17	10	14						
	Ave.	1.0	4.0	3.0		2.0	2.0	4.0	14.5	14.0	11.0	3.0	8.0				
Fawn	1	4	5	1		6	1	9	7	5	4	2	6	119	6.0	2.9	49
	2								5	5	8						
	3								8	8	9						
	4								13	8	5						
	Ave.	4.0	5.0	1.0		6.0	1.0	9.0	8.3	6.5	6.5	2.0	6.0				
Unclassed deer	1	9	11	23		26	17	21	23	28	37	20	21	519	26.0	8.6	33
	2								30	25	32						
	3								32	20	43						
	4								35	33	33						
	Ave.	9.0	11.0	23.0		26.0	17.0	21.0	30.0	26.5	36.3	20.0	21.0				
Total	1	58	71	78		64	38	91	142	132	123	42	122	2237	111.9	40.1	36
	2								137	121	140						
	3								170	119	139						
	4								161	145	144						
	Ave.	58.0	71.0	78.0		64.0	38.0	91.0	152.5	129.3	136.5	42.0	122.0				
Miles (Ave.)		5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0				
Km (Ave.)		8.0	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0				
Deer/10 mi (Ave.)		116.0	142.0	156.0		128.0	76.0	182.0	305.0	258.5	273.0	84.0	244.0		169.1	92.9	55
Deer/10 km (Ave.)		72.5	88.8	97.5		80.0	47.5	113.8	190.6	161.6	170.6	52.5	152.5		103.7	44.6	43
Bucks-in-velvet	1	0	0	0		0	0	0	0	2	1	0	3	20	1.0	1.3	134
	2								1	0	2						
	3								1	0	1						
	4								1	4	4						
	Ave.	0.0	0.0	0.0		0.0	0.0	0.0	0.8	1.5	2.0	0.0	3.0				

Table 4. Composition of deer herd seen during spotlight counts at Naval Magazine, Guam during FY 1986.

	1985			1986									Summary Statistics			
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL	AVE.	SD	CV-%
Unclassed buck	0	0	1	0	1	0	1	0	0	1	0	0	4	0.3	0.5	148
Spike	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	
2pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	
3pt	0	0	0	0	0	0	0	1	0	0	0	0	1	0.1	0.3	346
4pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	
Doe	2	2	2	2	10	1	3	1	3	3	0	1	30	2.5	2.5	102
Yearling	0	0	0	0	4	0	1	0	1	0	0	0	6	0.5	1.2	234
Fawn	0	1	1	0	1	0	3	1	0	1	0	0	8	0.7	0.9	133
Unclassed deer	0	1	6	2	3	1	3	2	7	4	0	0	29	2.4	2.3	96
Total	2	4	10	4	19	2	11	5	11	9	0	1	78	6.5	5.6	86
Miles traveled	14	14	14	14	14	14	14	14	14	14	14	14	168	14.0		
Km traveled	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	269	22.4		
Deer/10 mi	1.4	2.9	7.1	2.9	13.6	1.4	7.9	3.6	7.9	6.4	0.0	0.7	56	4.6	4.0	86
Deer/10km	0.9	1.8	4.5	1.8	8.5	0.9	4.9	2.2	4.9	4.0	0.0	0.4	35	2.9	2.5	86
Water Buffalo	21	53	24	44	78	18	29	21	43	36	30	55	452	37.7	17.8	47
Buffalo/10 mi	15.0	37.9	17.1	31.4	55.7	12.9	20.7	15.0	30.7	25.7	21.4	39.3	323	26.9	12.7	47
Buffalo/10 km	9.4	23.7	10.7	19.6	34.8	8.0	12.9	9.4	19.2	16.1	13.4	24.6	202	16.8	8.0	47

RECOMMENDATION

Continue spotlight counts at present intensity at NAVMAG and AAFB. Collect biological data from carcasses as available.

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1985. Job Progress Reports. Federal Aid to Fish and Wildlife Restoration, Department of Agriculture, Government of Guam, Agana, Guam.

Sokal, R.R. and F.J. Rohlf. 1969. Biometry. W.H. Freeman and Co., San Francisco. 776 pp.

Wheeler, M.E. 1979. The biology of the Guam deer. Aquatic and Wildlife Resources Division Technical Report No. 3, Department of Agriculture, Government of Guam, Agana, Guam. 53 pp.

Report prepared by: Paul Conry

FINAL REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-1
STUDY NO.: 1
JOB NO.: 3

JOB TITLE: Determination of Diet Quality of Guam Deer.

PERIOD COVERED: October 1, 1983 to September 30, 1986.

MAJOR RESEARCHER: Paul J. Conry

SUMMARY

Levels of the amino acid diaminopimelic acid (DAPA) in fecal samples were used as an index of overall diet quality (see Nelson and Davitt 1984 for methodology) for comparing the nutritional status of two deer (*Cervus unicolor*) herds on Guam: a southern deer herd at the Naval Magazine (NAVMAG), which occurs at low densities and has been decreasing over the past ten years and a northern deer herd at Andersen Air Force Base (AAFB), which occurs at high densities and has been increasing over the past six years. A fecal DAPA profiles was also established for a feral water buffalo (*Bubalus bubalis*) herd at NAVMAG. Fecal DAPA content of samples from the NAVMAG herd were significantly higher ($P<0.001$) than samples from the AAFB deer herd indicating that the NAVMAG deer herd has a higher quality diet than the AAFB deer herd. These data suggest that poor nutrition is not a factor in the low deer numbers at NAVMAG. Nutrient content of the key forage species *Pennisetum polystachyon* was analyzed from the AAFB and NAVMAG study sites and found to be low in crude protein content at both sites and low in calcium and phosphorous content at the NAVMAG site. Nutrient content of rumen material was analyzed from AAFB deer and found to be high in crude protein, calcium, and phosphorous content. No meaningful relationship was found between DAPA content of deer feces and percentage crude protein content of rumen material or percentage crude protein content of *Pennisetum polystachyon* . The limited nutritional profile obtained from rumen samples also suggests that AAFB deer are obtaining an adequately nutritious diet at the existing high population level. Additional work on the relationships between diet digestible energy (diet quality), dietary crude protein and DAPA levels is needed before conclusions can be made as to the applicability of DAPA studies on Guam.

BACKGROUND

The Guam Division of Aquatic and Wildlife Resources has monitored population trends for the island's two main sambar deer (*Cervus unicolor*) herds since 1963. A monthly spotlight-count, conducted over a fixed route, is used as an index of the population size and serves as the major method to assess relative abundance and trend over time. Data from spotlight counts indicate that the northern herd, found in the vicinity of Andersen Air Force Base (AAFB) and surrounding areas, occurs at much higher densities than the southern herd, found in the vicinity of the Naval Magazine (NAVMAG) and surrounding areas. In

FY 1986, an average of 134.3 deer were observed per 10 km of road surveyed at AAFB versus 2.9 deer per 10 km of road surveyed at NAVMAG (Aquatic and Wildlife Resources Division-DAWR, 1986). Until recently, both herds showed similar trends over time, depressed populations in the early 1960s that built up to record high levels in the early 1970s and declined through the late 1970s (Wheeler 1979). The AAFB herd bottomed out in 1979 and has steadily increased since then reaching near record high numbers in 1986 (DAWR 1986). In contrast, the NAVMAG herd exhibited a similar declining trend through the late 1970s but has continued to decline (DAWR 1986).

The factors contributing to the differing performance of the herds are unknown. Wheeler (1979) speculated that illegal hunting was the highest single cause of mortality for the Guam deer. Nutritional factors may also be involved as the herds come from areas with different soil types, the AAFB area having limestone soils and the NAVMAG area having a mixture of volcanic and limestone soils (Stone 1970). Studies into nutritional differences between the two herds or other causes of the differing population density and trend have not been initiated because of manpower and budget constraints.

The development of a new method of nutritional analysis, the diaminopimelic acid (DAPA) index of diet quality, provided a fast, inexpensive, and nonconsumptive means to monitor the nutritional well-being of ruminants (Nelson et al. 1982, Nelson and Davitt 1984). The new methodology involved collecting and analyzing fecal samples from target herds for diaminopimelic acid (DAPA) content, which is reportedly strongly correlated with diet digestible energy (Nelson et al. 1982, Nelson and Davitt 1984), and using DAPA levels as an index to diet quality. This study was initiated to statistically compare fecal DAPA profiles of the two deer herds on Guam to determine if diet quality, as expressed by high fecal DAPA levels, of the NAVMAG herd was considerably worse than the AAFB herd which would suggest that nutritional problems may be contributing to the low numbers of the NAVMAG herd.

As little work has been done to date on wildlife nutrition on Guam,this study was expanded to obtain additional information. A large herd of feral water buffalo (*Bubalus bubalis*) occurs on NAVMAG and is of interest for management purposes. During the course of this study a fecal DAPA profile was obtained for this water buffalo herd to establish baseline data for this species. Seasonal variation in nutritional quality of a key forage plant *Pennisetum polystachyon* was also investigated in this study as a means to establish the relationship between fecal DAPA profiles and the nutrient quality of a known key forage plant. Along a similar line of reasoning, nutrient quality of rumen material was compared with DAPA content of feces from individual animals to establish the relationship between some common indices of deer diet and fecal DAPA content. Nutrient quality of rumen material was also compared to nutrient quality of *Pennisetum polystachyon.*

OBJECTIVES

1. To investigate differences in diet nutritional quality as expressed by fecal DAPA content between the Pati Point, Andersen Air Force Base (AAFB) and Naval Magazine (NAVMAG) deer herds.

2. To establish baseline DAPA index values for the AAFB and NAVMAG deer and water buffalo herds both seasonally and between years.

3. To investigate the nutritional quality of the key forage plant *Pennisetum polystachyon* and its relationship to the DAPA profiles for the deer and water buffalo herds.

4. To investigate the nutritional quality of deer rumen material and its relationship to the DAPA content of fecal material.

PROCEDURES

Deer and water buffalo fecal samples and samples of the forage item *Pennisetum polystachyon* were collected on a monthly basis from Andersen Air Force Base (AAFB) and Naval Magazine (NAVMAG) during March 1984 - February 1986. Composite samples of (1) 3-pellets from each of 15 different fresh deer pellet-groups, (2) 10 ml of water buffalo fecal material from each of 15 different fresh droppings, and (3) approximately 100 gms of fresh grass *Pennisetum polystachyon* were collected monthly from each area. Fecal and rumen samples were also collected from deer carcasses examined at hunter check stations, road kills, and from deer confiscated from poachers. Grass, rumen and fecal samples were oven-dried prior to being sent for nutrient analysis to the Wildlife Habitat Management Services, Department of Forestry and Range Management, Washington State University. The Wildlife Habitat Laboratory perform DAPA (diaminopimelic acid) content analysis on fecal samples and crude protein, gross energy, calcium content and phosphorous content analysis on the grass and rumen samples (Nelson et al. 1982). Results of the nutrient analyses were returned to the author for statistical analysis. Differences in fecal DAPA content between deer and water buffalo samples were tested with a Mann-Whitney U-test. The relationship between DAPA content of feces and forage or rumen nutrient content was established and tested with the Pearson product-moment correlation coefficient (Sokal and Rohlf 1969).

RESULTS

Comparison of Diet Quality Between Deer Herds

Fecal DAPA profiles were determined for the AAFB and NAVMAG deer herds and the NAVMAG water buffalo herd from March, 1984 - February, 1986 (Table 1). The fecal DAPA profile for the NAVMAG deer herd tended to be consistently higher than the profile for the AAFB deer herd throughout the study period (Fig. 1). Fecal samples from NAVMAG deer had significantly higher (Mann-Whitney U-test, $U=416$, $n_1=23$, $n_2=23$, $P<0.001$) DAPA levels than fecal samples from AAFB deer. The DAPA content of NAVMAG samples averaged 0.915 mg/g (range=0.719-1.126 mg/g) whereas AAFB samples averaged 0.775 mg/g (range=0.592-0.957 mg/g). If fecal DAPA levels are a reliable indicator of overall diet quality of ruminants as proposed by Nelson et al. (1982), the significantly higher fecal DAPA profile for the NAVMAG deer herd indicates that it has a higher quality diet than the AAFB herd and suggests that nutritional problems are not a cause of the low densities and decreasing trend observed for the NAVMAG herd.

Fecal DAPA profiles for both deer herds were consistently higher than that for the water buffalo (Fig. 1). DAPA levels for water buffalo averaged 0.582 mg/g (range=0.484-0.820). As pointed out by Nelson et al. (1982), inferences as to comparative diet quality between deer and water buffalo cannot be made based on the differences in fecal DAPA content because the two species may differ in the composition of their rumen bacterial communities.

Similar to the results reported by Nelson and Davitt (1984) for temperate area species, DAPA profiles for Guam deer and water buffalo varied in pattern between years, varied among species, and varied within species (Fig. 1). In contrast to the cyclic seasonal patterns reported for temperate area species (Nelson and Davitt 1984), no consistent seasonal pattern was evident in DAPA profiles for deer or water buffalo on Guam. For

Table 1. Results of DAPA and chemical analysis of fecal and grass samples collected from Pati Point, Andersen Air Force Base and the Naval Magazine, Guam during March, 1984-February, 1986.

	DAPA index of fecal samples (mg/g)			% protein content	
Month/Year	AAFB deer	NAVMAG deer	NAVMAG water buffalo	AAFB grass	NAVMAG grass
1984					
Mar	0.652	0.722	0.517	7.36	4.13
Apr	0.655	0.801	0.484	4.45	4.79
May	0.687	0.933	0.540	4.78	3.49
Jun	0.950	0.913	0.765	4.45	2.56
Jul	0.921	1.115	0.820	4.63	2.34
Aug	0.800	0.719	0.535	3.47	4.02
Sep	0.957	0.787	0.547	6.32	3.89
Oct	0.615	0.840	0.559	7.39	4.33
Nov[1]					
Dec	0.793	1.004	0.654	7.01	4.11
1985					
Jan	0.740	0.845	0.563	8.55	5.14
Feb	0.805	0.947	0.517	7.41	5.18
Mar	0.775	0.764	0.538	7.54	4.37
Apr	0.850	0.909	0.662	5.61	4.70
May	0.863	1.000	0.522	7.55	4.77
Jun	0.934	1.012	0.550	4.96	4.87
Jul	0.906	1.029	0.527	4.38	4.18
Aug	0.747	1.126	0.621	5.73	3.54
Sep	0.713	1.044	0.610	7.83	3.53
Oct	0.729	1.090	0.587	7.73	6.01
Nov	0.733	0.880	0.521	8.23	4.06
Dec	0.739	0.902	0.636	7.92	2.58
1986					
Jan	0.672	0.895	0.587	6.64	2.07
Feb	0.592	0.778	0.536	7.21	2.35
Average	0.775	0.915	0.583	6.40	3.96
Min	0.592	0.719	0.484	3.47	2.07
Max	0.957	1.126	0.820	8.55	6.01

[1]Samples from November 1984 were destroyed during oven-drying because of an equipment malfunction.

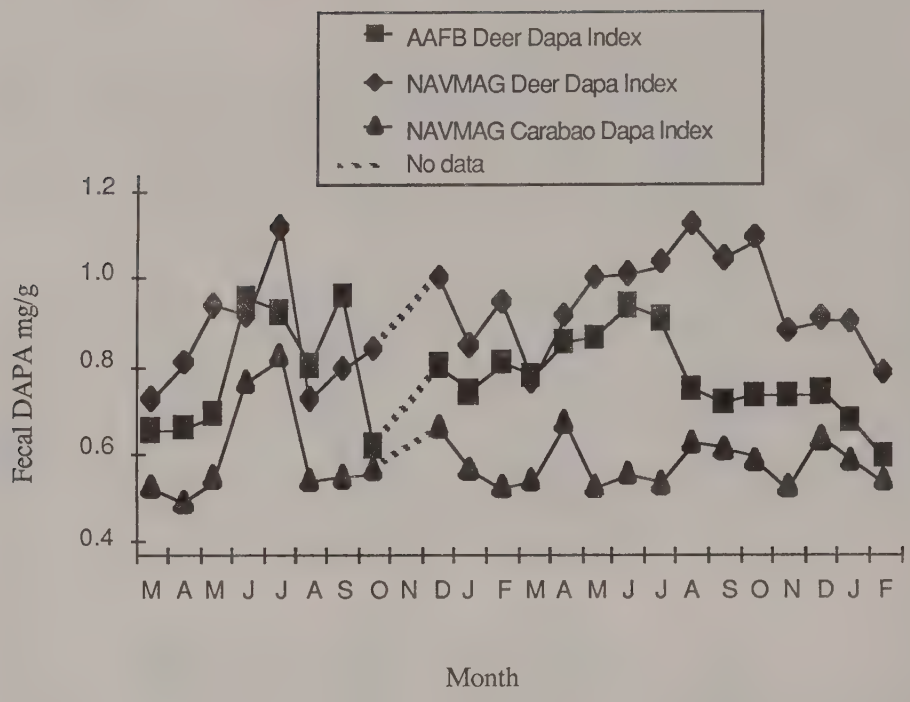

Figure 1. Fecal DAPA profiles for two deer herds and one water buffalo herd at Andersen Air Force Base (AAFB) and Naval Magazine (NAVMAG), Guam during the period March, 1984 through February, 1986.

example, high DAPA levels for NAVMAG deer occurred in May-July and December of 1984, and in May-October of 1985 and low levels occurred in March and August-September, 1984; March 1985; and February 1986. AAFB deer had high DAPA levels in June-September, 1984 and April-July, 1985 and low DAPA levels in March-May, October, 1984; August-December, 1985; and January-February, 1986. NAVMAG water buffalo had high DAPA levels only in June-July, 1984 and low levels in March-May and August-October, 1984; January-March, May-July, and November, 1985; and February, 1986. It is unknown how much seasonal variation actually exists in diet quality on Guam with a semi-tropical climate. The lack of a seasonal pattern in DAPA profiles could reflect a lack of consistent seasonal variation in diet quality or, if seasonal variation does occur, a lack of correlation with diet quality. Additional work on seasonal variation in diet quality is needed before conclusions about the relationship between diet quality and DAPA profiles can be made for Guam. However, DAPA profiles for both deer herds, and less so for water buffalo, did show some mild similarities in pattern over time (though not associated with seasons) suggesting a response to changing environmental conditions.

Relationship between Fecal DAPA and Nutrient Content of Forage

Nutrient content of the grass *Pennisetum polystachyon*, an important deer and water buffalo food item, sampled at both sites appeared to be low in % crude protein content, adequate in calcium and phosphorous content at AAFB, but low in calcium and phosphorous content at NAVMAG (Table 2). Percentage crude protein content averaged 6.40% (range=3.47-8.55%) at AAFB and 3.96% (range=2.07-6.01%) at NAVMAG, well below the 10-16% level needed for maintanence, production and lactation that is recommended as an adequate diet for the temperate mule deer *Odocoileus hemionus*, a similar species (Wallmo 1981:110). Calcium and phosphorous levels at AAFB, on limestone soils, averaged 0.45% and 0.33% and were well above the 0.20-0.25% level recommended for mule deer diets (Wallmo 1981:111). Calcium and phosphorous levels at NAVMAG, on volcanic soils, averaged 0.18% and 0.08% and were below the levels recommended for mule deer. The ratio of calcium to phosphorous in the forage at both sites, 1.4 at AAFB and 2.3 at NAVMAG, was within the level (C/P ratio < 5.0) recommended for mule deer diets (Wallmo 1981:111).

Only a weak relationship, if any, was found between the DAPA content of deer and water buffalo fecal samples and crude protein content of *Pennisetum polystachyon*. No relationship was evident between deer fecal DAPA content and crude protein content of grasses from NAVMAG ($r=+0.03$, $P>0.20$) but grass protein content was inversely related to water buffalo DAPA content ($r=-0.48$, $P<0.05$). A similar weak inverse relationship was found between deer fecal DAPA content and crude protein content of grass samples on AAFB ($r=-0.42$, $P<0.05$). The importance of the indirect relationship between the index of deer diet quality and nutrient content of a key forage item is unclear. It could be that crude protein content of *Pennisetum polystachyon*, a single item in the diet, is not strongly correlated to diet quality and as such no relationship is expected between *Pennisetum polystachyon* and DAPA levels. Nelson and Davitt (1984) reported that DAPA concentration was not correlated with diet crude protein in one controlled feeding experiment they reviewed. Additional information is needed on the relationship between crude protein content of *Pennisetum polystachyon* and diet quality in order to understand the relationship between forage quality and DAPA levels on Guam.

Relationship between DAPA content of feces and nutrient content of rumen material from individual deer

Fecal and rumen-content samples were collected from 40 deer during this study to investigate the nutrient quality of individual deer diets and the examine the relationship

Table 2. Nutrient content of *Pennisetum polystachyon*, a key deer and water buffalo forage item, collected monthly from Andersen Air Force Base (AAFB) and Naval Magazine (NAVMAG), Guam during March, 1984-February, 1986.

	AAFB					NAVMAG				
	% CP	GE (C/g)	% C	% P	C/P	% CP	GE (C/g)	% C	% P	C/P
1984										
Mar	7.36	4488	0.45	0.38	1.2	4.13	4333	0.23	0.10	2.3
Apr	4.45	4543	0.46	0.27	1.7	4.79	4394	0.33	0.09	3.7
May	4.78	4544	0.47	0.28	1.7	3.49	4405	0.28	0.09	3.1
Jun	4.45	4538	0.48	0.29	1.7	2.56	4508	0.16	0.07	2.3
Jul	4.63	4503	0.43	0.28	1.5	2.34	4355	0.19	0.07	2.7
Aug	3.47	4427	0.52	0.37	1.4	4.02	4429	0.18	0.07	2.6
Sep	6.32	4517	0.48	0.44	1.1	3.89	4476	0.16	0.08	2.0
Oct	7.39	4494	0.35	0.30	1.2	4.33	4479	0.13	0.08	1.6
Nov[1]										
Dec	7.01	4529	0.39	0.35	1.1	4.11	4408	0.16	0.06	2.7
1985										
Jan	8.55	4580	0.43	0.39	1.1	5.14	4372	0.17	0.08	2.1
Feb	7.41	4573	0.44	0.33	1.3	5.18	4312	0.19	0.08	2.4
Mar	7.54	4406	0.39	0.39	1.0	4.37	4302	0.16	0.09	1.8
Apr	5.61	4490	0.42	0.30	1.4	4.70	4377	0.15	0.10	1.5
May	7.55	4367	0.44	0.34	1.3	4.77	4477	0.17	0.08	2.1
Jun	4.96	4356	0.57	0.33	1.7	4.87	4260	0.13	0.11	1.2
Jul	4.38	4453	0.45	0.26	1.7	4.18	4304	0.20	0.07	2.9
Aug	5.73	4316	0.60	0.28	2.1	3.54	4327	0.18	0.08	2.3
Sep	7.83	4438	0.57	0.29	2.0	3.53	4406	0.17	0.06	2.8
Oct	7.73	4522	0.42	0.31	1.4	6.01	4251	0.14	0.08	1.8
Nov	8.23	4472	0.39	0.30	1.3	4.06	4423	0.15	0.06	2.5
Dec	7.92	4291	0.41	0.32	1.3	2.58	4247	0.17	0.08	2.1
1986										
Jan	6.64	4429	0.43	0.33	1.3	2.07	4273	0.19	0.08	2.4
Feb	7.21	4328	0.45	0.35	1.3	2.35	4229	0.18	0.09	2.0
Average	6.40	4461	0.45	0.33	1.4	3.96	4363	0.18	0.08	2.3
Min	3.47	4291	0.35	0.26	1.0	2.07	4229	0.13	0.06	1.2
Max	8.55	4580	0.60	0.44	2.1	6.01	4508	0.33	0.11	3.7

[1]Samples from November 1984 were destroyed during oven-drying because of an equipment malfunction.

between DAPA content of feces and nutrient content of rumen material. Results of nutrient and DAPA analysies are reported in Table 3. Fecal DAPA levels from individual deer (Table 3) averaged 0.808 mg/g (range=0.538-1.158) and were not significantly different (Mann-Whitney U-test, U=530, n_1=40, n_2=23, P>0.20) from DAPA levels obtained from the AAFB herd composite samples (Table 1).

Nutrient indices of percentage crude protein, percentage calcium content, and percentage phosphorous content of deer rumen material were far higher than the values found for *Pennisetum polystachyon* on AAFB (Table 2). Average crude protein content of rumen material was 15.6% (range=6.2-21.7%) which exceeded the 10-16% levels recommended as adequate for mule deer diets (Wallmo 1981:110). Likewise, the 2.15% average calcium content (range=0.55-4.44%) and 1.52% average phosphorous content (range=0.53-2.39%) of rumen material exceeded the 0.40% calcium content and 0.20-0.25% phosphorous content levels recommended for mule deer diets (Wallmo 1981:111). The calcium/phosphorous ratio of rumen material (average=1.4, range=0.8-2.2) was also well within the levels (C/P ratio < 5.0) recommended for mule deer (Wallmo 1981:111). The high nutrient quality of deer rumen material in contrast to the poor quality of *Pennisetum polystachyon* suggests that deer are selectively feeding on higher quality forage than *Pennisetum polystachyon* and that the poor nutrient quality of *Pennisetum polystachyon* is not of major concern. Cursory inspection of the rumen material analyzed in this study revealed a high incidence of fruits which could contribute to the higher quality diet. The limited nutritional profile obtained from rumen samples suggests that AAFB deer are obtaining an adequately nutritious diet at the existing high population level.

A weak inverse relationship was found between DAPA content of feces and percentage crude protein content of rumen material from individual deer (r=-0.36, P<0.05). Apparantly, no meaningful relationship exists between DAPA content of deer feces and the crude protein content of rumen material. The importance of this indirect relationship between the index of deer diet quality and curde protein content of the diet is unclear. It could be that crude protein content of the diet as expressed by crude protein content of rumen material is not closely related to diet quality as expressed by diet digestible energy levels. Nelson and Davitt (1984) reported that DAPA concentration was not correlated with diet crude protein in one controlled feeding experiment they reviewed. Nelson et al (1982) also pointed out that high crude protein levels in the diet does not necessary result in high nitrogen utilization as phenolic compounds in forage may interfere with nitrogen utilization. The relationship between dietary crude protein levels and diet digestible energy (diet quality) is unknown for deer diets on Guam. Additional information is needed on the relationship between dietary crude protein content and diet digestible energy in order to understand the relationship between diet quality and DAPA levels on Guam.

CONCLUSIONS

This study indicates that Naval Magazine (NAVMAG) deer have significantly higher (P<0.001) fecal levels of the ammino acid diaminopimelic acid than do deer at Andersen Air Force Base (AAFB). Assuming the reliability of fecal DAPA content as an indicator of overall diet quality (Nelson et al. 1982, Nelson and Davitt 1984), these results indicate that deer on NAVMAG have a significantly higher quality diet (P<0.001) than do deer on AAFB. These data further suggest that nutritional problems are not responsible for the consistently low deer numbers at NAVMAG. Other conclusions from this study are that no meaningful relationship exists between fecal DAPA content and percentage crude protein content of an important deer forage item (*Pennisetum polystachyon*). Likewise, no meaningful relationship was evident between the DAPA content of an individual deer's feces and the precentage crude protein content of forage material taken from the deer's rumen. A limited nutritional profile of the key forage species *Pennisetum polystachyon* at

Table 3. Summary results of DAPA content of feces and nutrient content of rumen material collected from 40 sambar deer (*Cervus unicolor*) on Guam during 1984-1986.

	Feces	Rumen material				
	DAPA content (mg/g)	% crude protein	Gross energy (C/g)	% calcium content	% phosphorous content	Calcium/ phosphorous ratio
Average	0.808	15.63	4992	2.15	1.52	1.4
Minimum	0.538	6.15	4542	0.55	0.53	0.8
Maximum	1.158	21.71	5539	4.44	2.39	2.2

both AAFB and NAVMAG was of poor quality in terms of the nutrient indices of crude protein content and calcium and phosphorous content and was below that recommended as adequate for mule deer diets in North America. A similar nutritional profile of rumen material obtained from northern herd animals was considerably better than the profile for *Pennisetum polystachyon* and was at or above the recommended levels for mule deer diets in North America. The limited nutritional profile obtained from rumen samples suggests that AAFB deer are obtaining an adequately nutritious diet at the existing high population level. Additional work on the relationships between diet digestible energy (diet quality), dietary crude protein and DAPA levels is needed before conclusions can be made as to the applicability of DAPA studies on Guam.

LITERATURE CITED

Aquatic and Wildlife Resources Division (DAWR). 1979-1986. Job Progress Reports. Federal Aid to Fish and Wildlife Restoration, Department of Agriculture, Government of Guam, Agana, Guam.

Nelson, J. R and B. B. Davitt. 1984. A regional cooperative DAPA research and development program. Proc. Western States and Provinces Elk Workshop. Edmonton, Alberta. pp. 148-163.

Nelson, J. R., R. M. Koes, W. H. Miller, and B. B. Davitt. 1982. Big game habitat management on a nutritional basis-a new approach. Western Elk Workshop. Flagstaff, Arizona. pp. 157-166.

Wallmo, O. C. (ed.). 1981. Mule and black-tailed deer of North America. Univ. Nebraska Press, Lincoln and London. 605 pp.

Wheeler, M. E. 1979. The biology of the Guam deer. Aquatic and Wildlife Resources Division, Technical Report No. 3, Department of Agriculture, Government of Guam, Agana, Guam. 53 pp.

Sokal, R. R. and F. J. Rohlf. 1969. Biometry. W. H. Freeman and Co., San Francisco. 776 pp.

Stone, B. C. 1970. The flora of Guam. Micronesica 6:1-659.

Report prepared by: Paul J. Conry

Authorizing Signature:

_____

HARRY T. KAMI
Chief, Aquatic & Wildlife Resources Division
Department of Agriculture
Government of Guam

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Preparation of a Status Report on Wild Pigs.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

OBJECTIVES

To prepare a status report on wild pigs to be used in planning future work.

RESULTS

Progress was made toward completion of this job during Segment 23. Reproductive tracts collected during Segment 22 and 23 were examined and analyzed for reproductive condition, fetal development, and breeding seasonality. Information on wild pig hunting, captive rearing, reproductive biology, and historical status and distribution was compiled from DAWR annual reports and library references for inclusion in the technical report. The technical report is now in preparation and should be completed during Segment 24.

RECOMMENDATION

Complete the manuscript during Segment 24 and publish the technical report.

Report prepared by: Paul Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Wild Pigs on Guam.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Pig hunter participation, effort, and harvest increased in FY 1986. An estimated 335 pig hunters spent 8,710 days hunting pigs and harvested an estimated 1,273 pigs, an increase of 14% in hunter participation, 68% in hunter effort, and 80% in harvest from FY 1985 levels. Hunter success increased from 47% in FY 1985 to 68% this year and the average take per successful hunter increased from 5.1 pigs in FY 1985 to 5.6 pigs in FY 1986. The effort expended per pig harvested also improved slightly from 7.3 days/pig in FY 1985 to 6.8 days/pig in FY 1986. Northwest Field and other areas on Andersen Air Force Base and Naval Communications Area Master Station (NAVCAMS) were the most popular pig hunting areas on Guam with Anao, Cotal (Tarzan Falls), and Bolanos Territorial Conservation Reserves and other private lands also identified as areas hunted.

BACKGROUND

The wild pig *(Sus scrofa)* is one of Guam's most popular game mammals. The wild pigs on Guam descend from stock introduced by the Spanish during their 300-year rule on the island. Wild pigs are found island-wide, though appear to be most numerous in the limestone forests of the north and the ravine forests of southern Guam. Depredation on agricultural crops is often a problem, especially for farmers in southern Guam during the dry season. Fieldwork on pigs in the past has been concentrated on military lands. There is a need to assess pig populations in other areas of the island, particularly in the south, where pigs may be under-harvested and where crop damage by pigs is a common complaint. The legal hunting season for pigs is year-round in southern Guam (south of Route 4) and October 1 through March 31, island-wide. Bags limits are 2 pigs per day and 30 per season.

OBJECTIVES

To monitor trends in pig population size and hunter participation and harvest.

PROCEDURES

1. Record pig sightings during deer spotlight counts, and observations of pigs or pig sign during other fieldwork.

2. Monitor hunter participation and harvest during the legal hunting season.

RESULTS

License sales decreased 7.2% during FY 1986 with 433 licenses sold throughout the year. All license holders were mailed a harvest questionnaire and responses were obtained from 115 persons (26.6%). Eighty-six percent of the respondents indicated they had hunted during FY 1986. Based on that percentage, an estimated 372 persons legally hunted game during the year. Hunters were asked to provide information on the amount of effort expended hunting, game harvested, and locations hunted and the following harvest statistics are based on the responses of 99 hunters that completed the questionnaire.

Pig harvest statistics improved during FY 1986 (Table 1). Ninety percent of the Guam hunters reported they hunted pigs during the FY 1986 season. Hunter success increased from 47% in FY 1985 to 68.5% in FY 1986. The average take per hunter also increased from 2.4 pigs in FY 1985 to 3.8 pigs in FY 1986. The average take per successful hunter was 5.6 pigs in FY 1986. Pig hunters spent more time in the field this past year, an average of 26 days per hunter versus 17.6 days per hunter in FY 1985, an increase of 48%. The amount of effort required to harvest a pig improved in FY 1986, 6.8 hunter-days per pig versus 7.3 hunter-days in FY 1985.

Estimates of hunter participation, effort, and harvest were derived from hunter questionnaires. An estimated 335 pig hunters spent 8,710 days hunting pigs and harvested 1,273 pigs in FY 1986. Those estimates are consistently higher than the estimates of 294 hunters spending 5,174 days and harvesting 706 pigs in FY 1985. In summary, FY 1986 had an increase in hunter participation (14%), hunter effort (68%), and hunter harvest (80%).

Pig hunting remained popular beyond the traditional 3-month October - December joint deer and pig season. Fifty-five percent of the pig hunters continued to hunt during January - March and 16% hunted during April - September in southern Guam.

The shotgun remained the weapon most commonly used to hunt pigs and was used by 67% of reporting hunters and took 65% of the pigs harvested. Bow hunting increased in popularity and became the second most popular weapon for pig hunting. The bow was used by 34% of the reporting pig hunters and accounted for 30% of the harvest. Handguns and rifles were used by fewer hunters, 9% and 7% respectively, and each accounted for 3% of the harvest. Twenty-one percent of the reporting hunters indicated they were successful in taking at least one daily limit of 2 pigs and many reported taking numerous daily limits.

The military bases on the northern end of the island were once again the most popular areas to hunt. Northwest Field, bow areas on AAFB, and NAVCAMS were hunted by 37%, 24%, and 20%, respectively, of the reporting hunters. Cotal (Tarzan Falls), Anao, and Bolanos Territorial Conservation reserves were hunted by 10%, 10%, and 8%, respectively, of the reporting hunters and 17% of the reporting hunters hunted on private property. The northern military bases received the greatest hunting pressure as reported by the respondents to the harvest questionnaire, Northwest Field, NAVCAMS, and AAFB received 630 hunter-days (28%), 514 hunter-days (23%), and 483 hunter-days (22%) respectively, of reported hunting effort. Territorial Conservation Reserves received 309 hunter-days (14%) and private property received 275 hunter-days (12%) of reported hunter effort.

An accurate record of hunting activity and harvest was recorded during mandatory check in and out procedures at NAVCAM and is reported in Table 2. During FY 1986, hunting

Table 1. Pig hunting statistics for FY 1986 as based on hunter responses to a harvest questionnaire.

a.	Total license sales for all game species	433
b.	Number of questionnaires sent out	433
c.	Number of questionnaires returned	115
d.	Percent of queried license buyers that responded	26.6%
e.	Number of reporting hunter (115) that hunted any species	99
f.	Percent of license buyers that hunted	86.0%
g.	Estimated total number of legal hunters	372
h.	Number of reporting hunters that hunted pigs	89
i.	Percent of reporting hunters that hunted pigs	90.0%
j.	Number of successful pig hunters	61
k.	Hunter success	68.5%
l.	Number of pigs taken by the 89 reporting pig hunters	339
m.	Average number of pigs taken per pig hunter	3.8
n.	Average number of pigs taken per successful hunter	5.6
o.	Estimated total number of legal pig hunters	335
p.	Estimated total legal pig take	1273
q.	Number of hunter days expended by 85 reporting pig hunters	2211
r.	Average number of days spent per reporting pig hunter	26.0
s.	Estimated total number of days spent hunting pigs	8710
t.	Days of hunting effort per pig taken	6.8
u.	Number of hunters that hunted after the end of the deer season	49
v.	Percent of hunters hunting after deer season	55.0%
w.	Number of hunters that hunted pigs in the south during the extended season (Apr.-Sept.)	14
x.	Percent of hunters that hunted in the south during the extended pig season	16.0%

Table 2. Hunter effort and pig take based on official hunter logs from Naval Communication Station and Northwest Field during FY 1986.

Month/Year	Naval Communication Station			Northwest Field			
	No. hunter sorties	No. hunter 8-hour days	Pig take	No. hunter days	No. hunter sorties	No. hunter 8-hour days	Pig take
1984							
October	407	242.5	26				
November	255	139.5	18				
December	180	105.5	13				
1985							
January	119	70.5	11	No data provided this fiscal year			
February	160	92	17				
March	154	87	13				
Total	1275	737	98				
Effort/ pig taken	13.0	7.5	--				

pressure and take decreased from FY 1985 levels with total harvest down 26% from 133 pigs in FY 1985 to 98 pigs in FY 1986 and hunter effort down 23% from 962.5 8-hour days in FY 1985 to 737 8-hour days in FY 1986. It also required slightly more effort to harvest a pig in FY 1986 than the previous year, 7.5 hunter-days in FY 1986 versus 7.2 hunter-days in FY 1985. No data were provided for Northwest Field.

RECOMMENDATIONS

Continue to monitor the annual pig harvest and hunter participation.

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1985. Job Progress Report - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Report prepared by: Paul Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 4

JOB TITLE: Wild Pig Biology and Natural History

PERIOD COVERED: October 1, 1985 to September 30, 1986.

OBJECTIVES

To obtain basic biological information on wild pigs through the examination of hunter-killed pig carcasses.

SUMMARY

Biological data were collected from 22 pig carcasses examined at hunter checking stations during FY 1986. The entire backlog of 20 female reproductive tracts were dissected and analyzed for reproductive status, fetal development, ovarian development, and breeding seasonality. Data are currently being incorporated into a technical report under Job W-1-2-1.

BACKGROUND

The wild pig (*Sus scrofa*) is one of Guam's most popular game mammals. In order to improve management of this wildlife resource, the Division began to collect biological information from hunter-killed pig carcasses during Segment 21 under Job W-2-2. This activity continued during Segment 22 & 23, when it was developed as a separate Job.

PROCEDURES

1. Conduct Hunter Checking Stations at selected areas and examine hunter-killed pig carcasses.

2. Collect basic biological information from carcasses pertaining to reproductive biology, growth rates, body condition, and food habits.

RESULTS

Biological data was collected from pig carcasses that were harvested on Northwest Field, Andersen Air Force Base during FY 1986. Twenty-two pigs were examined and measured and reproductve tracts were collected from seven sows for further analysis. Other work completed during this segment includes the processing of the entire backlog of 20 reproductive tracts collected during segments 21-23. Those reproductive tracts were dissected and analyzed for reproductive status, fetal development, ovarian development,

and seasonality in breeding. Data are currently being incorporated into a status report under Job W-1-21.

RECOMMENDATION

Continue this Job through Segment 24 incorporating the results into a status report under Job W-1-2-1.

Report prepared by Paul J. Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-2
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Preparation of a Status Report on Philippine Turtle Doves.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

OBJECTIVES

To prepare a status report on Philippine Turtle Doves for use in planning future work.

RESULTS

A draft version of this report was completed during Segment 23 and is currently in internal review.

RECOMMENDATION

This job will be completed and published in Segment 24.

Report prepared by: Paul Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-2
STUDY NO.: 1
JOB NO.: 2

JOB TITLE: Population Numbers and Distribution of Philippine Turtle Doves.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

The 2-year moratorium placed on the hunting of Philippine Turtle-Doves in June of 1985 continued and no hunting occurred in July 1986. Stationary counts significantly declined at Northwest Field (NWF, $P<0.10$) and Conventional Weapons Storage Area (CWA, $P<0.001$) on Andersen Air Force Base (AAFB). An average of 35.1 turtle-doves were recorded per count at NWF, down 17% from FY 1985 levels and an average of 29.4 turtle-doves were recorded per count in the CWA, down 31% from FY 1985 levels. Turtle-doves were observed on 40 of 44 spring game bird surveys conducted during May-June, 1985 and 1986. Turtle-doves were distributed throughout the island and found in highest numbers at Cocos Island, Orote Point, Barrigada Navy golf course, and Northwest Field. The largest decrease in numbers between 1985-1986 occurred at Northwest Field. A nesting study on turtle-doves was completed during FY 1986 (Conry in review). Nesting success was significantly lower ($P=0.02$) in forest habitat (0.7%) than urban habitat (21.2%) during 1984-1985. A follow-up study in urban habitat in 1986 found nesting success had significantly declined ($P=0.002$) to 0.7%. Predation was the major cause of nest failure accounting for 93% of all losses. The brown tree snake was identified as the major predator responsible for 78.8% of all losses. Small mammals also preyed on nests accounting for 14.1% of all losses but only took eggs. The native Marianas Fruit-Dove and White-throated Ground-Dove also continued to decline with only one ground-dove observed in 25 station counts on NWF and one observed on 24 roadside counts in CWA. No fruit-doves have been observed since early in FY 1985.

BACKGROUND

The Philippine Turtle Dove (*Streptopelia bitorquata*) was introduced to Guam by the Spanish during their early colonization of the region, circa 1771 (Baker 1951) and has been regulated as a game bird since as early as 1903. The most recent hunting regulation, implemented in 1984 and remains in effect to date, restricted the hunting season to the month of July with a daily limit of 5 birds and a season limit of 20 birds. However, a recent nest predation study (Conry, in review) indicated that high nest predation primarily by the introduced brown tree snake (*Boiga irregularis*) caused extremely low nesting success as low as 0.7% in both forested and urban habitats. The poor nesting success combined with decreasing numbers prompted concern for the ability of the dove population to produce enough birds to withstand the heavy predation losses and support recreational hunting without continued losses in the base population of doves. As hunting mortality is the only controllable source of loss to the population, the Division proposed a 2-year

moratorium on hunting to reduce overall losses and attempt to maintain the dove population until the snake can be brought under control. In June 1985, the Director of Agriculture adopted the moratorium that closed the Philippine Turtle Dove season for the 1985 and 1986 calendar years. Prior to the July 1987 season, the Department will evaluate the status of the dove population and nesting success and decide whether to reopen the season or continue the moratorium.

OBJECTIVES

1. To determine present population levels and distribution, and monitor population trends.

2. To investigate nesting success and causes of nest failures.

PROCEDURES

Call-count and roadside-count surveys were conducted at Northwest Field (NWF) and the Conventional Weapons Storage Area (CWA) on Andersen Air Force Base (AAFB). Both surveys were conducted twice monthly in early morning. The call-count survey consisted of counting the number and species of doves seen or heard during a 5-minute period at 10 stations in NWF plus tallying the number of doves seen in route between stations. The roadside-count survey at CWA involved counting the number of Philippine Turtle-Doves seen while driving at 25 km per hour along an established 32 km route. The Philippine Turtle-Dove is also censused in a twice weekly roadside-count survey conducted in 3 areas of northern Guam (Job W-1-3). Presence and numbers of turtle-doves were recorded during spring game bird surveys conducted island-wide during May-June, 1985 and 1986. The surveys consisted of 5-minute station counts at up to 10 stations per route with the number of birds seen or heard recorded at each station. Twenty-one routes were surveyed in 1985 and 23 were surveyed in 1986. Results are summarized as average number of birds recorded per station. See project report FW-2R-23: W-2-2-2 for a map of survey locations.

Nesting success of the turtle-dove was studied in urban habitat during May-July, 1986 within the airfield compound of AAFB. Active nests were located and individually marked for observation and visited on a 2-10 day interval, most at 2-4 days, until the nest was lost or the young fledged. In cases where eggs or young disappeared, the site was carefully searched for clues indicating the cause of the disappearance. Data were collected and analyzed according to the Mayfield method (Mayfield 1975). Details of this study are presented in Conry (in review).

RESULTS

Dove Hunting Statistics

A 2-year moratorium on hunting Philippine Turtle-Dove was adopted by the Director of Agriculture in June of 1985. Consequently, no legal hunt took place during FY 1985 and FY 1986.

Population Surveys

Call count surveys and roadside counts were continued in NWF and the Conventional Weapons Magazine (CWA) on Andersen Air Force Base (Table 1). The mean number of doves observed per count at NWF declined from 42.4 in FY 1985 to 35.1 in FY 1986, a continuation of the downward trend of the past 3 years.

Table 1. Results of Philippine Turtle-Dove surveys at Conventional Weapons Area (CWA) and Northwest Field (NWF) on Andersen Air Force Base, Guam during FY 1986.

	NWF Surveys				CWA Surveys		
Month	1	2	3	Average	1	2	Average
1985							
October	36	45		40.5	32	36	34.0
November	32	29		30.5	29	32	30.5
December	21	30		25.5	23	32	27.5
1986							
January	36	37		36.5	25	25	25.0
February	30	29		29.5	21	21	21.0
March	31	25		28.0	36	28	32.0
April	38	47		42.5	31	37	34.0
May	49	45	39	44.3	33	24	28.5
June	38	33		35.5	40	29	34.5
July	36	31		33.5	36	27	31.5
August	47	36		41.5	27	29	28.0
September	33	24		28.5	25	27	26.0
Average count				35.1			29.4

Counts in FY 1986 were 17% lower than FY 1985, a statistically significant difference at the P=0.10 level (Mann Whitney U-Test, U = 367.5, P<0.10; Sokal and Rohlf 1981).

Roadside counts in the CWA also continued to decline for the third year. Counts were significantly lower in FY 1986 than in FY 1985 (Mann Whitney U-Test, U = 499.5, P<0.001). Mean numbers observed per count in the CWA declined from 42.8 in FY 1985 to 29.4 in FY 1986, a decline of 31%.

The native Mariana Fruit-Dove (*Ptilinopus roseicapilla*) and White-throated Ground-Dove (*Gallicolumba xanthonura)* have continued to decline. In FY 1984, 33 fruit-doves and 13 ground-doves were counted versus 1 fruit-dove and 3 ground-doves observed in FY 1985. In FY86, no fruit-doves were detected on either the NWF or CWA counts and only one ground-dove was detected on the CWA count on 27 Dec 85 and a second ground-dove was sighted on a NWF count on 23 Jan 86.

The declining trend in the turtle dove and native dove populations as evident in the counts at NWF and CWA further documents the general decline in Guam birds.

Spring Game Bird Surveys

Turtle-doves were distributed throughout the island and recorded on 40 of 44 spring game bird counts conducted during 1985 and 1986 (Table 2). Cocos Island had the highest station count and the largest increase in doves between 1985 and 1986. Northwest Field, Barrigada Navy Golf Course and Orote Point also had relatively high station counts. The largest decrease in dove numbers occurred at Northwest Field. Other locations surveyed had relatively low numbers of turtle-doves.

Nesting Success

Conry (in review) provides a detailed analysis of turtle-dove nesting success in northern Guam. Nest success was very low, in forested areas on NWF (0.7%) during 1984-1985 but better, although still low in urban habitat on the airfield compound (21.2%). A follow-up study in urban habitat in 1986 found that nesting success had significantly declined (P=0.002) to 0.7%. Predation was the major cause of egg and nestling mortality throughout the study and accounted for 93% of all losses. The brown tree snake *(Boiga irregularis)* was identified as the major predator and was responsible for 78.8% of all losses. Small mammals also preyed on dove nests accounting for 12.8% of all losses but only took eggs. Predation is clearly having a devastating impact on the reproduction of the turtle-dove and assumably other forest nesting birds.

RECOMMENDATION

1. Continue call count and roadside count surveys in northern Guam to monitor distribution, relative abundance and population trends of the Philippine Turtle-Dove.

2. Discontinue hunting Philippine Turtle-Doves until the population recovers (Conry in prep).

Table 2. Numbers of Philippine Turtle-Doves observed per count and average number of birds per station as detected in spring game bird surveys at various locations on Guam during June - July, 1985 and 1986. Values in the trend column are the difference between the average station count between years. If the number of stations counted per survey differed between 1985 and 1986, the number counted in 1985 is displayed in parenthesis.

Survey location	No. of stations	1985 doves/ count	1985 ave./ station	1986 doves/ count	1986 ave./ station	Trend + or - 85-86
Tarague Basin, AAFB	10			7	0.7	
Conventional Weapons Mag.	10			8	0.8	
Northwest Field	10	33	3.3	14	1.4	-1.9
NAVCAMS	10	2	0.2	0	0.0	-0.2
Capital Improvement Rd., Yigo	10	3	0.3	6	0.6	+0.3
Mt. Santa Rosa	8	7	0.9	3	0.4	-0.5
Y-sengsong Rd., Dededo	10	2	0.2	4	0.4	+0.2
Two Lovers Point	10	1	0.1	5	0.5	+0.4
Andersen South	10	3	0.3	4	0.4	+0.1
Navy Golf Course, Barrigada	10	27	2.7	30	3.0	+0.3
Barrigada Hill	(4) 7	0	0.0	5	0.7	+0.7
Toto Pipeline	8	4	0.5	2	0.3	-0.2
Nimitz Hill	10	3	0.3	6	0.6	+0.6
Reserve Craft Beach Rd., Piti	4	8	2.0	2	0.5	-1.5
Orote Point, Naval Station	6	13	2.2	8	1.3	-0.9
Pulantat, Yona	9	7	0.8	7	0.8	0.0
Cross Island Rd., Yona	10	2	0.2	1	0.1	-0.1
Naval Magazine	10	9	0.9	6	0.6	-0.3
Umatac	10	0	0.0	3	0.3	+0.3
Dandan, Inarajan	10	2	0.2	1	0.1	-0.1
Ija, Inarajan	5	3	0.6	0	0.0	-0.3
Merizo	6	3	0.5	4	0.7	+0.2
Cocos Island	(6) 7	23	3.8	41	5.9	+2.1

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1985. Job Progress Report. Federal Aid to Fish and Wildlife Restoration, Dept. of Agriculture, Government of Guam, Agana, Guam.

Baker, R.H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. University of Kansas Pub. 3(1):1-359.

Conry, P. J. In Prep. Ecology of the Philippine Turtle-Dove on Guam. Tech. Report No. 5. Division of Aquatic & Wildlife Resources, Dept. of Agriculture, Mangilao.

Conry, P.J. In Review. High nest predation by brown tree snakes on Guam. Submitted to Condor.

Report prepared by Paul Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Preparation of a Status Report on Black Francolin.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

OBJECTIVES

To prepare a status report on Black Francolin to be used in planning future work.

RESULTS

This project was inactive during Segment 23.

RECOMMENDATIONS

Initiate work on this project during Segment 24 and complete the job.

Report prepared by: Paul Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Black Francolin on Guam.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Black Francolin were legally hunted during the months of January and July, 1986 during which an estimated 56 hunters spent 414 days hunting and harvested 297 birds. More hunters took to the field during the July season as 48 hunters spent 216 days hunting and harvested 144 birds. During the January season an estimated 41 hunters spent 197 days hunting and harvested 152 birds. The Dandan area was the most popular area to hunt francolin on the island and accounted for 55% of the hunting effort and 62% of the harvest. The Bolanos and Cotal (Tarzan Falls) Territorial Conservation Reserves, Nimitz Hill, and Ija areas were also hunted. Black Francolin numbers appear to have stabilized in the Dandan area with no significant difference ($P>0.20$) detected in station counts between FY 1985 and FY 1986. Black Francolin were found on 22 of 44 spring game bird surveys conducted throughout the island during 1985 and 1986. Francolin occurred on all surveys south of Route 4 and a small population was detected north of Route 4 in shrub-grass habitat in the Barrigada Hill area. The Pulantat area appears to have the largest population of birds with an average of 9.9 and 6.8 birds/station detected during the 1985 and 1986 surveys, respectively. Nimitz Hill, Cross Island Road, Naval Magazine, Umatac, Dandan, Ija, and Merizo survey routes had moderate to high numbers of birds with averages of 3-6 birds detected per station. Francolin populations appear well established throughout southern Guam and able to sustain the current levels of recreational hunting.

BACKGROUND

In 1961, 171 Black Francolin *(Francolinus francolinus)* were introduced in southern Guam as part of the Foreign Game Bird Introduction Program of the U.S. Fish and Wildlife Service. Surveys conducted in 1980 indicated the population was adequately established in most parts of southern Guam to open a hunting season. Regulations were promulgated to open a 1-month season in December 1981 with a 4 bird daily limit and a 20 bird season limit. Francolin populations continued to increase from 1980-1982 but hunting pressure remained low, probably because of the unfamiliarity of the hunting public with the sporting qualities of the bird. With the bird population consisently increasing and little hunting pressure, the francolin season and bag limits were further liberalized in FY 1983 to a 2 month-split season, 1 month in January and 1 month in July, with the bag limit increased to 5 birds per day, no season limit. Francolin hunting has increased in popularity and Guam hunters are successfully harvesting birds during the open seasons. Regulations implemented in FY 1983 remain in effect to date with hunter participation and adherence to game laws monitored by spot checks by Division biologists and conservation officers.

OBJECTIVES

To determine current relative abundance and current distribution of Black Francolin on Guam and monitor population trends and hunter harvest.

PROCEDURES

1. Conduct annual island-wide spring game bird surveys (station counts) to monitor distribution and status of francolin throughout the island (Fig. 1).

2. Conduct twice weekly station-count surveys during May-June to monitor pre-hunting season status of francolin population in Dandan, Inarajan.

3. Monitor hunter harvest via an annual harvest questionnaire. Collect information on hunter participation, effort, harvest, and areas hunted.

RESULTS

Francolin Hunting Statistics

License sales decreased 7.2% during FY 1986 with 433 licenses sold throughout the year. All license holders were mailed a harvest questionnaire and responses were obtained from 115 persons (26.6%). Eighty-six percent of the respondents indicated they had hunted during FY 1986. Based on that percentage, an estimated 372 persons legally hunted game during the year. Hunters were asked to provide information on the amount of effort expended hunting, game harvested, and locations hunted and the following harvest statistics are based on the responses of 99 hunters that completed the questionnaire.

Black Francolin hunting did not draw as large a hunter participation as the big game seasons. In FY 1986, 15% of the Guam hunters reported they hunted francolin, 11% during the January season, 13% during the July season, and 15% overall (Table 1). Hunter success was 82% in January, 77% in July, and 87% overall with an average harvest of 3.7 birds in January (4.6/successful hunter), 3.0 birds in July (3.9/successful hunter) and 5.3 birds overall (6.2/successful hunter). The average harvest in January is surprisingly higher than July when the grasses are shorter and the birds more active and visible.

Francolin hunters expended an average of 4.8, 4.5, and 7.4 days hunting in January, July, and over the entire season, respectively. The hunting effort expended per bird harvested was 1.3 days/bird in January, 1.5 days/bird in July, and 1.4 days/bird overall, slight increases over FY 1985 levels.

Estimates of total hunter participation, effort, and harvest were based on hunter questionnaires. In FY 1986, an estimated 56 hunters spent 414 hunter days and harvested 297 birds over the entire season. In contrast, 104 hunters spent 624 days hunting and harvested 468 birds in FY 1985 with FY 1986 showing a decrease in hunter participation (46%), hunter effort (34%), and hunter harvest (37%).

Dandan remained the most productive area to hunt francolin accounting for 62% of the birds harvested and 55% of the effort. The Bolanos and Cotal (Tarzan Falls) Conservation Reserves, Nimitz Hill, and Ija areas were also hunted.

Figure 1. Map of spring game bird surveys conducted on Guam during 1985-1986.

Table 1. Black Francolin (BLFR) harvest statistics for FY 1986.

	Jan 86	Jul 86	Total
a. Total license sales for year			433
b. Hunter questionnaires mailed out			433
c. Number of hunter questionnaires returned			115
d. Percent of license buyers reporting			26.6%
e. Number of respondents (115) that hunted any species			99
f. Percent of license buyers that hunted FY 86			86.0%
g. Estimated total number of legal hunters FY 86			372
h. Number of reporting hunters that hunted BLFR	11	13	15
i. Percent of reporting hunters that hunted BLFR	11.0%	13.0%	15.0%
j. Number of successful BLFR hunters	9	10	13
k. Hunter success	82.0%	77.0%	87.0%
l. Number of BLFR taken by reporting hunters	41	39	80
m. Average number of BLFR taken per hunter	3.7	3.0	5.3
n. Average number of BLFR taken per successful hunter	4.8	3.9	6.2
o. Estimated total number of legal BLFR hunters	41	48	56
p. Estimated total legal BLFR harvest	152	144	297
q. Reported number of days spent hunting	53	58	111
r. Average number of days spent hunting	4.8	4.5	7.4
s. Estimated total number of days spent hunting	197	216	414
t. Number of days spent hunting per BLFR taken	1.3	1.5	1.4
u. Number of BLFR taken per day hunting	0.77	0.67	0.71

Hunters were also asked about their hunting habits. No one reported taking a daily limit of 5 birds during the season and 2 hunters (13%) reported they hunted with bird dogs. Fourteen birds were reported as shot and lost versus the 80 birds harvested, a crippling loss of 17.5%. A crippling loss of 38% and 26% were reported in FY 1984 and FY 1985. (AWR 1984, 1985)

The estimated total hunter participation, effort, and harvest seemed far higher than actual francolin hunting activity. The inflated estimates are probably related to the fact that successful hunters report their hunting history more readily than unsuccessful hunters.

Call Count Surveys

Ten call-count surveys were conducted in the Dandan area during May-June, 1986 (Table 2) and compared with spring counts in 1985. No significant difference (Mann-Whitney U-Test, $U=34$, $n_1=10$, $n_2=6$, $P>0.20$) was detected in the number of birds detected per station between 1985 (average=5.1, range=3.7-6.1, n=6) and 1986 (average=5.5, range=3.9-6.3, n=10). The Dandan population has apparently stabilized at a level of about 5-6 birds per station and seems productive enough to support the existing level of harvest. Hunters reported harvesting at least 49 birds in the Dandan area and the total estimated harvest was 184 birds.

Spring Game Bird Surveys

Black Francolin were detected on 22 of 44 spring game bird surveys (Fig. 1) conducted during 1985 and 1986 (Table 3). Francolin were found on all surveys south of Route 4 and on the Barrigada Hill and Navy Barrigada Golf Course surveys north of Route 4. This population in northern Guam has apparently become established in the scrub-grass habitat in the vicinity of the Naval Air Station, Agana and the antenna fields in the Barrigada area. The Pulantat area had the highest station counts during both years, average of 9.9 and 6.8 birds/station in 1985 and 1986, respectively, whereas other areas, Nimitz Hill, Cross Island Road, Naval Magazine, Umatac, Dandan, Ija, and Merizo had averages of 3-6 birds/station. The average number of birds detected per station increased on 7 of the survey routes between 1985 and 1986 and decreased on 5 of the routes. The largest increases between years occurred in the Cross Island Road, Dandan, and Ija areas and the largest decreases occurred in the Pulantat and Barrigada Hill areas. Francolin populations are well established throughout southern Guam and a small population has become established in shrub-grass habitat in north-central Guam.

RECOMMENDATIONS

1. Continue to monitor francolin population status, distribution, and hunter harvest.

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1984-5. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Table 2. Results of Black Francolin surveys conducted in the Dandan area of southern Guam during May - June, 1986.

Month/date	No. stations	No. birds detected	Ave. no. birds/station
15 May	10	55	5.5
23 May	10	51	5.1
27 May	10	60	6.0
30 May	10	60	6.0
Average count May			5.65
3 June	10	48	4.8
7 June	10	63	6.3
9 June	10	62	6.2
12 June	10	55	5.5
16 June	10	52	5.2
20 June	10	39	3.9
Average count June			5.32
Average count May-June, 1986			5.45

Table 3. Numbers of Black Francolin (BLFR) observed per count and average number of birds per station as detected in spring game bird surveys at various locations on Guam during May-June, 1985-1986. Values in the trend column are the difference between the average station count between years. If the number of stations counted per survey differed between 1985 and 1986, the number counted in 1985 is displayed in parenthesis.

Survey location	No. of stations	1985 BLFR/ count	1985 ave./ station	1986 BLFR/ count	1986 ave./ station	Trend + or - 85-86
Tarague Basin, AAFB	10			0	0.0	
Conventional Weapons Mag.	10			0	0.0	
Northwest Field	10	0	0.0	0	0.0	0.0
NAVCAMS	10	0	0.0	0	0.0	0.0
Capital Improvement Rd., Yigo	10	0	0.0	0	0.0	0.0
Mt. Santa Rosa	8	0	0.0	0	0.0	0.0
Y-sengsong Rd., Dededo	10	0	0.0	0	0.0	0.0
Two Lovers Point	10	0	0.0	0	0.0	0.0
Andersen South	10	0	0.0	0	0.0	0.0
Navy Golf Course, Barrigada	10	2	0.2	0	0.0	-0.2
Barrigada Hill	(4) 7	9	2.3	2	0.3	-2.0
Toto Pipeline	8	0	0.0	0	0.0	0.0
Nimitz Hill	10	31	3.1	34	3.4	+0.3
Reserve Craft Beach Rd., Piti	4	0	0.0	3	0.8	+0.8
Orote Point, Naval Station	6	11	1.8	14	2.3	+0.5
Pulantat, Yona	9	89	9.9	61	6.8	-3.1
Cross Island Rd., Yona	10	36	3.6	58	5.8	+2.2
Naval Magazine	10	38	3.8	37	3.7	-0.1
Umatac	10	46	4.6	49	4.9	+0.3
Dandan, Inarajan	10	34	3.4	44	4.4	+1.0
Ija, Inarajan	5	23	4.6	28	5.6	+1.0
Merizo	6	35	5.8	31	5.2	-0.6
Cocos Island	(6) 7	0	0.0	0	0.0	0.0

Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.H. Freeman Company. San Francisco. 859 pp.

Report prepared by: Paul J. Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-4
STUDY NO.: 1
JOB NO.: 3

JOB TITLE: Survey and Inventory of the Native Land Birds on Guam.

PERIOD COVERED: October 1, 1985 to September 30, 1986

SUMMARY

The decline of the native avifauna of Guam continued as shown by roadside counts, transect counts and Guam Rail surveys. For the first time no birds were observed during the circular plot transect at east Ritidian Point. One rail was captured on Andersen Air Force Base (AAFB) and at least one more located at the same area. The center of distribution of the remaining native forest birds on Guam continues to be the Conventional Weapons Storage Area (CWSA) and Northwest Field (NWF) on Andersen Air Force Base in Northern Guam.

BACKGROUND

Since the early 1960's, census data has documented the decline in both range and numbers of Guam's native land birds. Roadside counts initiated in 1960 over four routes in southern, central and northern Guam by the Guam Division of Aquatic and Wildlife Resources (DAWR) have provided an index to the decline (DAWR, 1974-1984). From 1979 to 1981 estimates of the population trends were made by the DAWR based on variable circular plot techniques (Reynolds et al. 1980) and from station counts in central and northern Guam (DAWR, 1980-1982). From June to July of 1981, an intensive forest bird survey utilizing variable-circular plot techniques along randomly located transects were conducted by the U.S. Fish and Wildlife Service with the cooperation of the DAWR (Engbring and Ramsey, 1984). Some of these transects have been repeated in recent years by the DAWR (1982-85).

Native land birds are now primarily restricted to northern Guam with the center of distribution of native forest birds located on NWF at AAFB. Exceptions are the the Vanikoro Swiftlet (known only from one cave in central Guam), Mariana Gallinule (found over most of Guam in restricted and declining wetlands), Micronesian Starling (also found on Cocos Island), and the Yellow Bittern (declining but found in savannah and second-growth vegetation over the entire island) (DAWR, 1974-1985).

Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Conry 1986, Savidge 1986a, 1986b).

A captive breeding program for the Guam Rail and Guam subspecies of the Micronesian Kingfisher was successfully begun in 1983 (DAWR 1984-1985). The Guam Rail is now breeding in captivity on Guam and at the Bronx Zoo and the Conservation and Research Center (CRC) of the National Zoological Park, in Front Royal, Virginia. The Kingfisher is now found in captivity at six zoos on the mainland, and bred successfully for the first time at the Bronx Zoo, Philadelphia Zoo and CRC during the summer 1985.

OBJECTIVES

To monitor population trends of the native land birds on Guam.

PROCEDURES

1. Roadside counts were conducted at bi-weekly intervals on three routes in northern Guam (Figure 1) by DAWR Conservation Officers. These routes were driven at approximately 6-9 km per hour beginning at sunrise. Numbers and species of all birds seen or heard were recorded, irrespective of the distance from the observer.

2. The Pajon Basin (East Ritidian Point) variable circular plot transect was surveyed by DAWR personnel in March 1986 (Figure 2). This transect has been run on an irregular basis since September of 1981. Prior to censusing, personnel received training in distance estimation and species identification to ensure comparable data collection. Stations were premarked and placed 150m apart along the transects to minimize the possibility of observing the same birds from different stations. Stations were censused using the eight minute variable circular-plot techniques as described by Reynolds et. al. (1980).

3. Surveys for Guam Rails using tape recorded playbacks of their calls were conducted in the flightline area on AAFB that since 1984 had the last known population (DAWR, 1984).

4. A survey of the Mariana crow was carried out in CWSA and NWF on AAFB using tape recorded playbacks of the Crows calls by Gary Michael, Philadelphia Zoological Society in cooperation with the DAWR.

RESULTS

Roadside counts done on three routes in northern Guam (see tables 1,2,3,4) continued to document the decline of all of the native species. The only exception was the Yellow Bittern, *Ixobrychus sinensis,* which showed a slight increase from 3.7 in 1985 to 11.6 in 1986 on the NWF roadside count. Noteworthy was the disappearance of the Mariana Fruit Dove, *Ptilinopus roseicapillus,* from all three routes for the first time. As in 1985 (DAWR 1985) only a single Guam Rail was seen in NWF. The Micronesian Starling, which was observed on both the NWF and North routes last year, was observed only in NWF in low numbers this year. In addition to the population on Cocos Island, starlings are now restricted to housing areas at various locations on the island. Introduced species also showed declines. Most notable was the Black Drongo which declined on all routes.

A single circular plot survey transect was run at East Ritidian Point in March 1986 (Table 5). For the first time since this survey was begun in 1981, no birds were observed. This completes the extirpation of both native and introduced birds from this area.

Fig. 1. Location of Northwest Field, North-central and North roadside count routes in northern Guam.

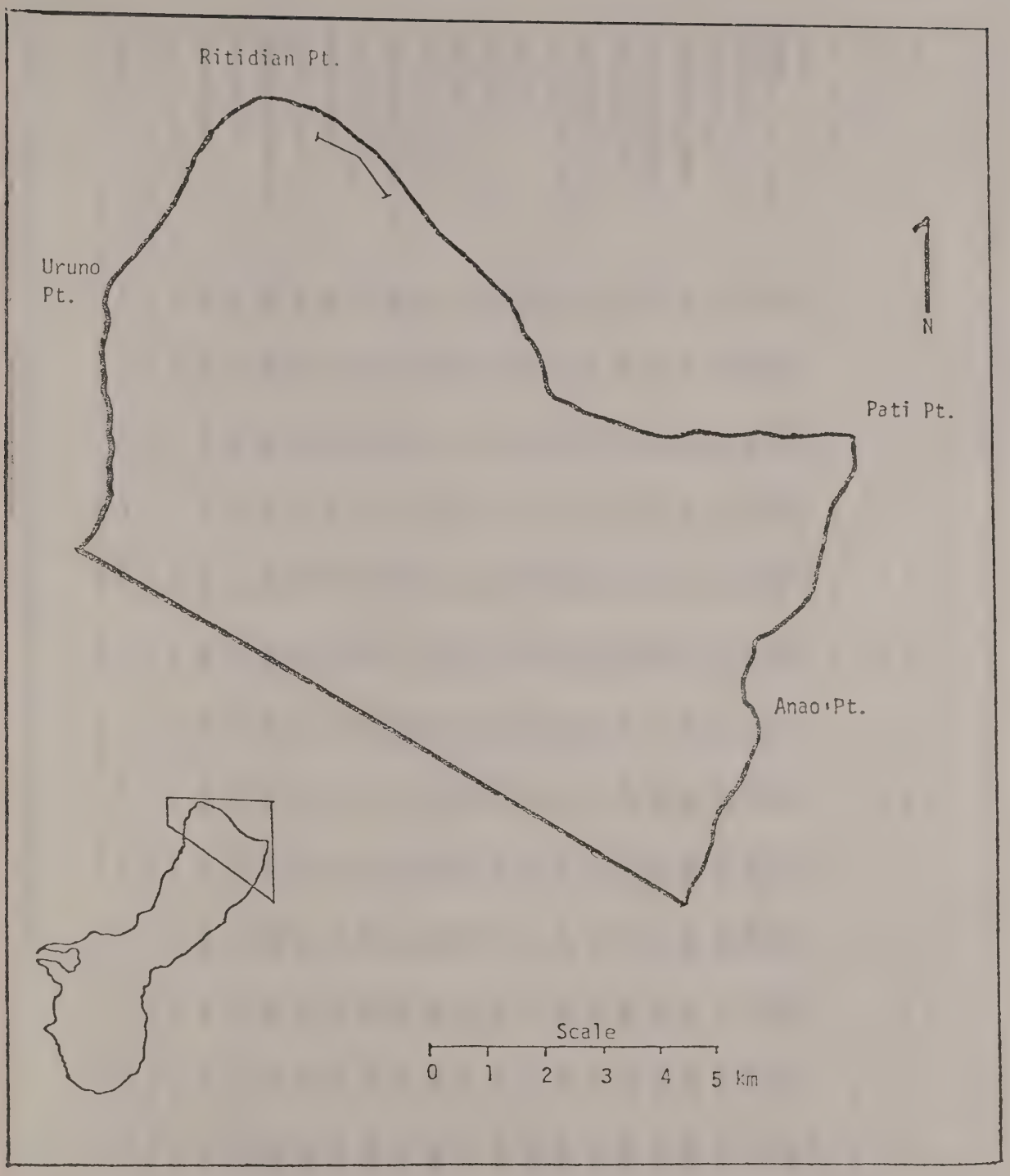

Figure 2. Location of Pajon Basin (East Ritidian Point) transect.

Table 1. Average number of birds per 100 Km observed each month on the North roadside count during Fiscal Year 1986.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Count	X/100 Km
Yellow Bittern	2.00	2.00	4.00	0.00	4.00	2.00	1.00	0.00	0.00	2.00	2.00	2.00	21.00	0.81	2.06
Mariana Crow	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.04	0.10
Black Drongo	15.00	4.00	10.00	14.00	7.00	3.00	15.00	13.00	1.00	11.00	16.00	26.00	135.00	5.19	13.22
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Golden Plover	91.00	35.00	79.00	131.00	59.00	149.00	44.00	4.00	0.00	0.00	0.00	73.00	665.00	25.58	65.12
White-throated Ground-Dove	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	2.00	0.08	0.20
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micronesian Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P.T. Dove	14.00	0.00	4.00	4.00	4.00	9.00	12.00	8.00	3.00	1.00	11.00	13.00	83.00	3.19	8.13
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chestnut Mannikin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eurasian Tree Sparrow	9.00	0.00	3.00	13.00	1.00	22.00	13.00	11.00	2.00	3.00	6.00	8.00	91.00	3.50	8.91
Micronesian Starling	0.00	0.00	6.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00	9.00	0.35	0.88
White Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Km	118.45	40.39	77.89	81.43	81.27	114.91	120.22	82.08	40.88	69.04	78.86	115.71	1021.13		
Miles	73.60	25.10	48.40	50.60	50.50	71.40	74.70	51.00	25.40	42.90	49.00	71.90	634.50		
Counts	3.00	1.00	2.00	2.00	2.00	3.00	3.00	2.00	1.00	2.00	2.00	3.00	26.00		

Table 2 Average number of birds per 100 Km observed on the North-Central roadside count during Fiscal Year 1986.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Count	X/100 Km
Yellow Bittern	0.00	0.00	1.00	2.00	3.00	0.00	5.00	0.00	1.00	0.00	1.00	4.00	17.00	0.68	3.22
Mariana Crow	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.16	0.76
Black Drongo	13.00	4.00	11.00	20.00	12.00	12.00	12.00	5.00	8.00	7.00	10.00	21.00	135.00	5.40	25.57
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Golden Plover	253.00	211.00	418.00	290.00	422.00	383.00	343.00	9.00	0.00	0.00	4.00	218.00	2551.00	102.04	483.27
White-tipped Ground-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micronesian Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P.T. Dove	12.00	8.00	9.00	19.00	15.00	12.00	31.00	17.00	26.00	11.00	23.00	17.00	200.00	8.00	37.89
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chestnut Mannikin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eurasian Tree Sparrow	19.00	4.00	14.00	38.00	38.00	12.00	19.00	15.00	5.00	6.00	5.00	19.00	194.00	7.76	36.75
Micronesian Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Km	62.12	18.51	42.81	63.09	41.84	40.72	59.22	39.43	39.75	20.44	38.95	60.99	527.87		
Miles	38.60	11.50	26.60	39.20	26.00	25.30	36.80	24.50	24.70	12.70	24.20	37.90	328.00		
Counts	3.00	1.00	2.00	2.00	1.00	2.00	3.00	2.00	2.00	1.00	2.00	3.00	24.00		

Table 3. Average number of birds per 100 Km observed each month on the Northwest Field roadside count during Fiscal Year 1986.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Count	X/100 Km
Yellow Bittern	11.00	0.00	2.00	3.00	6.00	6.00	7.00	8.00	2.00	2.00	2.00	3.00	52.00	2.08	11.62
Mariana Crow	17.00	0.00	3.00	7.00	2.00	8.00	5.00	0.00	2.00	3.00	9.00	31.00	87.00	3.63	19.44
Black Drongo	129.00	0.00	69.00	104.00	144.00	122.00	184.00	146.00	130.00	88.00	74.00	75.00	1265.00	50.60	282.64
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Golden Plover	46.00	0.00	29.00	67.00	59.00	70.00	39.00	0.00	0.00	25.00	20.00	40.00	395.00	15.80	88.26
White-throated Ground-Dove	0.00	0.00	0.00	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	0.48	2.68
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micronesian Kingfisher	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	2.00	5.00	0.20	1.12
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P.T. Dove	65.00	0.00	14.00	27.00	78.00	41.00	79.00	36.00	62.00	40.00	49.00	60.00	551.00	22.04	123.11
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Rail	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.04	0.22
Chestnut Mannikin	4.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.24	1.34
Eurasian Tree Sparrow	0.00	0.00	0.00	3.00	0.00	10.00	6.00	0.00	5.00	0.00	0.00	0.00	24.00	0.96	5.36
Micronesian Starling	4.00	0.00	0.00	1.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	2.00	9.00	0.36	2.01
White Tern	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	4.00	0.16	0.89
Km	53.75	0.00	39.59	35.57	37.34	32.51	48.28	36.69	38.95	37.01	33.64	54.23	447.56		
Miles	33.40	0.00	24.60	22.10	23.20	20.20	30.00	22.80	24.20	23.00	20.90	33.70	278.10		
Counts	3.00	0.00	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	2.00	24.00		

Table 4. Results of Northwest Field, North, and North Central roadside counts showing the mean number of birds per 100 Km of travel, the standard deviation (St. Dev.) and the coefficient of variation (CV).

Species	Northwest Field			North			North Central		
	Mean	St. Dev	CV	Mean	St. Dev.	CV	Mean	St. Dev.	CV
Yellow Bittern	11.62	1.85	88.78	2.06	1.27	156.68	3.22	0.99	145.33
Mariana Crow	19.44	5.55	153.01	0.10	0.20	509.90	0.76	0.80	500.00
Black Drongo	282.64	22.31	44.09	13.22	3.62	69.76	25.57	3.16	58.56
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Golden Plover	88.26	16.65	105.38	65.12	23.68	92.60	483.27	87.92	86.16
White-throated Ground-Dove	2.68	2.40	500.00	0.20	0.27	353.27	0.00	0.00	0.00
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micronesian Kingfisher	1.12	0.50	250.00	0.00	0.00	0.00	0.00	0.00	0.00
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P.T. Dove	123.11	12.95	58.74	8.13	2.45	76.74	37.89	4.50	56.25
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Rail	0.22	0.20	500.00	0.00	0.00	0.00	0.00	0.00	0.00
Chestnut Mannikin	1.34	0.88	366.41	0.00	0.00	0.00	0.00	0.00	0.00
Eurasian Tree Sparrow	5.36	2.03	211.52	8.91	3.68	105.13	36.75	6.97	89.84
Micronesian Starling	2.01	0.76	210.33	0.88	1.23	355.62	0.00	0.00	0.00
White Tern	0.89	0.80	500.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5. Forest birds seen at Pajon Basin on transect counts. Numbers are average total number of birds counted by 2 observers at ten stations at Pajon Basin (East Ritidian Pt.), Guam from September 1981 to January 1985.

Species	DATE											
	6/18/81*	6/2/82	5/19/83	6/28/83	7/28/83	8/31/83	9/30/83	10/27/83	12/5/83	5/15/84	1/29/85	3/26/86**
Guam Rail	0	0	0	0	0	1.0	0	0	0	0	0	0
Mariana Fruit-Dove	5.5	9.5	2.0	1.0	1.0	2.0	0	0	0	0	0	0
Philippine Turtle-Dove	0	0	0	3.0	2.5	15.5	21.5	10.5	17.0	9.5	0.5	0
White-throated Ground-Dove	.5	1.5	4.5	1.0	0	4.0	1.5	1.5	1.5	2.5	0	0
Micronesian Kingfisher	14.5	8.5	12.0	23.0	18.0	15.5	18.0	9.5	20.0	13.0	2	0
Mariana Crow	14	16.5	18.6	28.0	25.5	25.0	20.0	26.5	32.5	18.0	25.5	0
Rufous-fronted Fantail	36.5	27.5	22.0	21.5	6.0	2.0	2.0	1.5	0	0	0	0
Guam Broadbill	3.0	11.5	2.5	8.5	10.5	8.0	6.0	1.0	0	0	0	0
Micronesian Starling	76.0	79.5	71.5	63.0	75.0	61.0	48.5	51.0	41.0	35.5	3.5	0
Cardinal Honeyeater	15.5	16.5	15.5	17.0	17.0	9.0	9.5	15.0	4.0	1.0	0	0
Bridled White-eye	54.0	49.0	1.5	0	0	0	0	0	0	0	0	0

* 1981 survey was conducted by U.S.F.W.S. and DAWR staff. 1982 to 1985 survey was conducted by DAWR staff.
** On 3/26/86 survey only 7 stations were completed due to inclement weather.

From 22 September to 24 November 1985, a study of the breeding biology of the Mariana Crow on Guam was conducted by Gary Michael, of the Philadelphia Zoological Garden in cooperation with the DAWR staff (Michael 1986). In November, using tape recorded crow calls to locate crows on territory, Michael estimated 75 crows, still remaining in CWSA and NWF.

Tape recorded calls of the Guam Rail were used unsuccessfully on several ocassions at the flightline area on AAFB to attempt to locate rails in their last known habitat. In late September a Guam Rail was captured near the dog kennels on AAFB by Air Force personnel. At least one additional rail was located nearby the capture site using tape recorded rail calls. The captured rail was taken to the DAWR captive breeding facility. These were the first rails observed in the wild on Guam since July 1985 (DAWR 1985).

Roadside census work, the circular plot transect done at East Ritidian Point, observations made incidental to Philippine Turtle Dove counts done by the DAWR, Mariana Crow census work done by Gary Michael of the Philadelphia Zoo and observations made incidental to capturing Micronesian Kingfishers, suggest that NWF and CWSA on AAFB remain the center of distribution of most of Guam's native avifauna.

RECOMMENDATIONS

1. Continue bi-monthly roadside counts over the three routes in northern Guam.
2. Continue census of the Guam Rail when appropriate.
3. Continue a yearly census of the Mariana Crow in order to estimate population size and distribution on Guam.
4. Continue breeding biology studies and attempts to snake proof nest sites of the Mariana Crow on Guam.
5. Establish a working agreement with the Division of Fish and Game, Commonwealth of the Northern Mariana Islands to monitor the population size of the Mariana Crow on Rota.
6. Develop and implement methods for control of the brown tree snake.
7. Continue efforts to captive breed endemic endangered native land birds on Guam and at stateside zoos.
8. Implement plans to translocate Guam Rails to Rota, C.N.M.I. for purposes of establishing a wild population in a snake-free environment.

LITERATURE CITED

Conry, P. J 1986, In prep. High nest predation by the brown tree snake on Guam. Aquatic and Wildlife Resources, Dept. of Agriculture, Govt. of Guam, Agana, Guam.

Engbring, John and F.L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: Results of a 1981 survey. U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-84/20.

Guam Aquatic and Wildlife Resources Division, 1974-1984. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Reynolds, R.T., J.M. Scott and R.A. Nussbaum. 1980. A variable circular-plot method for censusing birds. Condor 82(3): 309-314.

Savidge, J. A. 1986a. The role of disease and predation in the decline of Guam's avifauna. Ph.D. Thesis. University of Illinois, Urbana-Champaign.

Savidge, J. A. 1986b, in press. Extinction of an island avifauna by an introduced snake. Ecology.

Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-23
SUB-PROJECT NO.: W-5
STUDY NO.: 1
JOB NO.: 2

JOB TITLE: The Current Status, Distribution and Natural History of Marianas Fruit Bats.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Guam's fruit bat population is currently estimated at 525 to 625 animals. The island's single colony of bats used two roosts on Pati Point during the year. No known cases of illegal hunting of bats occurred during the year. In FY 1986, 13,448 frozen fruit bats were imported to Guam from other islands for human consumption, an increase of 33.4% from the previous year.

BACKGROUND

The Marianas fruit bat (*Pteropus mariannus mariannus*) is endemic to the Mariana Islands and has been under investigation by the Guam Division of Aquatic and Wildlife Resources (DAWR) since 1962 (DAWR 1964-1984). These bats, considered a delicacy by Chamorro residents, steadily declined in number during the 1960's (Perez 1972). Thereafter, annual surveys revealed that only a few dispersed, solitary bats remained in the prime habitat on Guam which once supported colonies containing hundreds of bats (Wheeler and Aguon 1978, Wheeler 1979). Reasons for the decline included: increased human population pressures that resulted in overhunting and permanent habitat destruction, commercial exploitation of this food species, periodic severe typhoons, the lack of an adequate enforcement staff, and delays by the local legislature in passing protective legislation (Wheeler 1979). The Marianas fruit bat and the little Marianas fruit bat (*P. tokudae*) finally received full protection from hunting in 1973. Both species were placed on Guam's territorial Endangered Species List in 1981 and on the U.S. Endangered Species List on August 27, 1984. Marianas fruit bat abundance began to increase in 1980 and by 1982, Guam's population had grown to an estimated 850 to 1,000 animals. The island's fruit bat population was estimated at 695-800 animals in FY 1985.

OBJECTIVES

To monitor the population size and study the natural history of Marianas fruit bats in the Mariana Islands.

PROCEDURES

1. Survey fruit bat distribution and numbers in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) as initiated in the late 1970s.

    a. Conduct annual surveys of fruit bats along Guam's northern cliffline with periodic surveys made elsewhere on the island. The emphasis of surveys should be to search for solitary bats and additional bat colonies.

    b. Conduct monthly censuses at known bat colonies on Guam.

    c. Assist the CNMI Division of Fish and Wildlife (CNMIDFW) with surveys of fruit bats on other islands as needed.

2. Record information on the behavior and reproduction of fruit bats in colonies.

3. Determine habitat use of fruit bats. Visit abandoned roosts of colonies and record information about terrain and the size and abundance of vegetation present.

4. Monitor fruit bat imports to Guam from other islands in Micronesia and the Pacific.

5. Investigate illegal hunting of fruit bats on Guam.

    a. Visit abandoned roosting sites of colonies to determine illegal hunting effort.

    b. Assist Conservation Officers with investigations of bat poaching.

RESULTS

Sizes and Locations of Bat Colonies on Guam

Guam's single colony of Marianas fruit bats roosted at two known sites on Pati Point during FY 1986. North Pati Point Site 3 (NPP3) was initially occupied in June 1985 (DAWR 1985) and was used by bats during most of FY 1986 (Table 1). Bats made temporary use of a second site, North Pati Point Site 1 (NPP1), on five occasions during the year, with portions of the colony residing there four times and the entire colony there once (Table 2). This roost is located only 200 m west of NPP3 and is a traditional site that has been used extensively during the past five years (DAWR 1981-1985).

Human disturbances caused roosts to be abandoned at least twice during the year. In two instances, once by biologists on 11 January and again on 17 March by Air Force personnel, people approached the roost at NPP1 too closely, causing the colony to leave the site and move to NPP3. On a third suspected occasion on 8 August, large numbers of bats were observed flying and roosting in a disturbed manner in the vicinity of NPP1 and the Weapons Storage Area (WSA). Later that same day, a freshly cut trail through the forest was found on a lower terrace behind the WSA and indicated that trespassers had been in the area, perhaps walking as far east as NPP3. Causes for other movements were not determined although strong winds in early November were possibly the reason for about 200 bats taking up residence at NPP1. This location appears to be better protected from northeasterly winds than NPP3. Two searches were made at each roost site during the year (NPP3 on 25 February and 8 August; NPP1 on 3 December and 27 March) to look for evidence indicating that illegal hunting had occurred and caused the abandonment of the roosts. No signs of poaching were found during these searches. Evidence therefore

Table 1. Approximate dates of use of two roost sites by a colony of Marianas fruit bats on Guam.

Site	Approximate period of use of bats
North Pati Point - Site 1	1 to 27 November 1985, 13 December to 11 January 1986, 10 February to 17 March 1986, and 8 August 1986.
North Pati Point - Site 3	18 June 1985 to 10 February 1986, 17 March to 8 August 1986, and 9 August 1986 to present.

Table 2. Counts of Marianas fruit bats at roosts on Anderson Air Force Base, Guam in FY 1985 and FY 1986.

Date	North Pati Point		Total
	Site 1	Site 3	
7 Oct 1985	0	485	485
22 Nov.	200	290	490
2 Dec.	0	498	498
23 Dec.	182	244	426
22 Jan. 1986	0	535	535
25 Feb.	448	0	448
31 Mar.	0	328	328
5 May	10	427	437
30 May	0	365	365
25 Jun.	0	401	401
24 Jul.	0	385	385
8 Aug.	*	0	-
12 Aug.	0	+	-
18 Sep.	0	415	415

* = A large number of bats were flying and roosting in a disturbed manner in the vicinity of Site 1.
\+ = Bats present at roost but no count made.
\- = No total count made.

indicates that people approaching fruit bat roosts too closely can cause them to abandoned, even when no hunting occurs.

Censuses of fruit bats roosting on Pati Point varied by several hundred animals during the year (Table 2). Counts totaled approximately 500 bats from October to January but declined in February and March, when two changes in the roost site of the colony occurred. From May to September, approximately 400 bats were recorded during monthly censuses. This decline in numbers suggests that a portion of the colony moved to a new roost. However, several searches of the cliffline and plateau between Pajon Point and Tarague Point failed to find additional colonies, and there were no reports of newly located colonies in northern Guam during the year. This may indicate that about 100 bats emigrated from Guam to Rota during February or March.

Surveys of Fruit Bats on Guam

Censuses of fruit bats at colonies ranged from 328 to 535 animals, with the highest count occurring in January (Table 2). An estimate of the island's population of fruit bats at the end of FY 1986 was determined using the September count. Because some individuals were probably hidden by thick foliage, the total number of adults in the colony was likely to be 10 to 20% higher than the actual number counted. In addition, approximately 65% of the adults in the colony were harem females (DAWR 1985), with approximately 7% of these animals possessing unweaned young (see Natural History). These figures provide an estimate of 455 to 500 adults and 20 to 25 juveniles, or a total of 475 to 525 bats, in the colony in September.

Sightings of solitary fruit bats were made during the year in the Conventional Weapons Storage Area on AAFB (5 sightings), along the cliffline at Naval Facility (1 sighting), approximately .5 km south of the Potts Junction and Route 9 intersection in Dededo (1 sighting), at the Tweed's Cave area on NavCAMS (1 sighting), and at Fena Lake on Naval Magazine (2 sightings). Aside from the colony at Pati Point, an estimated 25 to 50 fruit bats are believed to live solitarily or in small groups along the island's northern cliffline that extends from Bijia Point to Iates Point. An additional 25 to 50 animals probably inhabit Naval Magazine, Talofofo and Malojloj. Based on these figures, Guam's island-wide population of fruit bats is estimated to contain 525 to 625 animals. This amount is lower than the FY 1984 estimate of 695 to 800 animals (DAWR 1985).

Surveys of Fruit Bats on Rota

The DAWR assisted the CNMIFWD with a survey of fruit bats on Rota from 21-30 August. Methods used to count bats were similar to those employed by Wiles (in prep.) in a survey of bats on Guam in 1984. Searches for colonies and accurate counts of bats within them were emphasized during Rota's survey. An airplane flight around the island was used to locate colonies prior to the start of ground work. In addition, station counts overlooking forested areas were made to determine the occurrence of solitary bats around the island. These methods provide more accurate counts of bats than evening dispersal counts (Lemke 1984) or station counts (Wheeler 1980) as used in previous surveys of the island.

Three bat roosts were discovered during the aerial survey and each was visited from the ground. Counts of roosting bats were made at each location with a 15-60X spotting scope and were increased by 10-20% to account for bats hidden in foliage. At the colony at Uyulan Hulo (also known as As Mundo), 1,182 bats were counted with an estimate of 1,300-1,420 animals made. At As Puepuenge, 297 bats were counted and 330-360 estimated to be present. A third colony at Palii had 30-40 bats present. A total of 1,660-1,820 bats were estimated to reside in colonies on Rota. Occasional solitary bats were

noted during station counts around the island and probably totaled several hundred animals. Preliminary totals for the island are about 1,850-2,100 bats residing on the island. A more complete report of the survey will be written by CNMIDFW staff.

Natural History

Food Habits - Information on the foods of Marianas fruit bats on Guam and Rota was gathered by interviewing island residents, by finding evidence of bats feeding, by direct observations of bats foraging in the wild, and by feeding fruits and flowers collected in the wild to a captive bat. Twenty-one species of plants were recorded in FY 1986 as being eaten by fruit bats (Table 4). Overall, including data gathered from previous years (DAWR 1983), twenty-nine species of plants are known to be eaten by bats in the Marianas. This list includes 20 different fruits, 10 flowers, and the leaf stems of one tree.

Reproduction - During FY 1986, 62 to 97 harem females were identified monthly at North Pati Point Sites 1 and 3 and examined visually through a spotting scope for the presence of unweaned young. Females with young comprised 7.2 to 14.0% of the females identified (Table 3). There did not appear to be a seasonal peak in the birth of young. As in FY 1985 (DAWR 1985), most (90%) of the juveniles observed were judged to be small-sized; no large young were noted during the year. These data suggest that juveniles are being lost by predation and that brown tree snakes (*Boiga irregularis*), as the only arboreal predator on Guam, are responsible. Snakes may be preying on young fruit bats left at the colony at night, when their mothers go to feed. Predation may also occur when the young are carried to feeding sites in the forest and left on their own for short periods while the mother feeds.

Predation - One probable instance of snake predation on a young fruit bat was recorded in FY 1986. On 12 August, a dead baby bat was found in limestone forest near the top of the hillside north of the WSA at a location approximately 1.7 km west on the fruit bat colony at NPP3. The bat appeared to have died only a few hours before it was found, as indicated by the condition of its body. The fur on the crown of the head appeared to be matted, as would probably result following a snake bite in which a small amount of snake saliva was deposited at the wound. The bat's size was similar to that of the young which are disappearing from island's colony. Measurements taken from the bat were: total body length, 135 mm; foot, 41 mm; ear, 20 mm; forearm, 85 mm; and weight, 90 gr.

Illegal Hunting

Poaching has been a major factor preventing the recovery of Guam's fruit bat population during the 1980s. There were no known cases of illegal hunting of bats during FY 1986. This is the first year since records were kept in 1981 that actual or attempted bat poachings have not been recorded.

Fruit Bat Imports

During FY 1986, 90,556 fruit bats were requested for import (Table 5), an increase of 36.9% from the previous year (DAWR 1985). An estimated total of 13,448 frozen fruit bats in 134 shipments were actually shipped to Guam from other islands in FY 1986 (Table 6). This figure is based on known data for 11 months of the year but were estimated for February, when data were missing. The estimate for February was based on the average monthly import total for the rest of the year. The estimated total for the year is an increase of 33.4% over the previous year.

Western Samoa was the major source of fruit bats for the Guam market in FY 1986, accounting for 52% of all imported bats (Table 6). This country has been the primary

Table 3. Number of harem females observed with unweaned young at North Pati Point from October 1985 to September 1986.

	No. of Females observed	No. of Females w/o young	No. of Females w/ small young	No. of Females w/ medium young	No. of Females w/ large young	% of Females with young
Oct	86	74	12	0	0	14.0
Nov	77	68	8	1	0	11.7
Dec	74	64	10	0	0	13.5
Jan	84	75	7	2	0	10.7
Feb	89	79	9	1	0	11.2
Mar	75	67	5	3	0	10.7
Apr	82	75	6	1	0	8.5
May	62	57	5	0	0	8.1
Jun	79	71	7	1	0	10.1
Jul	73	64	9	0	0	12.3
Aug						No Data
Sept	97	90	7	0	0	7.2
TOTAL		789	85	9	0	10.7

Table 4. Information on foods of Marianas fruit bats gathered during FY 1986. Evidence was obtained on Guam (G) and Rota (R).

Species	Plant Part Eaten	Notes
Agave rigida	flower	Residents report flowers eaten (R).
Aglaia mariannensis	fruit	Fruit found eaten in March (G).
Annona reticulata	fruit	Fruit eaten by captive bat (G).
Artocarpus atilis	fruit	Residents report fruit eaten (R).
Artocarpus mariannensis	fruit	Residents report fruit eaten (R).
	leave	Fruit found eaten in August (R). Leaf stems found eaten in December (G).
Calophyllum inophyllum	fruit	Fruit eaten by captive bat (G).
Carica papaya	fruit	Fruit found eaten in November (G).
Casuarina equisetifolia	unknown	Feeding activity observed in September (G). Plant part was not identified.
Ceiba pentandra	flower	Nectar eaten by captive bat (G). Residents report flowers eaten (G, R).
Cocos nucifera	flower	Residents report flowers eaten (R).
Cycas circinalis	fruit	Fruit found eaten in February (G). Residents report fruit eaten (R).
Eleaocarpus sphaericus	flower	Residents report flowers eaten (R).
Erythrina variegata	flower	Nectar eaten by captive bat (G). Residents report flowers eaten (R).
Ficus prolixa	fruit	Residents report fruit eaten (R).
Freycinetia reinwardtiana	flower	Pollen and fleshy flower bracts eaten by captive bat (G).
"Gayi"	flower	Residents report flowers from this vine (perhaps *Mucuna*) are avidly eaten (R).
Guettarda speciosa	flower	Residents report flowers eaten (R).
Mammea odorata	fruit	Fruit found eaten in November and February (G). Residents report fruit eaten (R).
Musa sp.	fruit	Residents report fruit of wild plants eaten (R).
Neisosperma oppositifolia	fruit	Fruit found eaten in November and December (G). Residents report fruit eaten (R).
Pandanus tectorius	fruit	Fruit found eaten in October (G). Residents report fruit eaten (R).

Table 5. Numbers of frozen bats requested for import to Guam between October 1, 1985 to September 30, 1986.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	No. of Permits Issued
Western Samoa	5,400	2,000	2,000	2,000	6,000		6,000	700	1,400	3,000	10,000	8,100	46,700	56
Philippines	20		3,000	2,000	6,000		6,000		2,430	4,975	500		24,925	31
Palau	715	459	575	815	2,150	1,728	530	1,315	953	834	1,325	395	11,804	157
Truk	20	100	110	200		490		230	200	600	30	750	2,730	23
Pohnpei	10	50	200	551		150			200	575	190	80	2,006	23
American Samoa	500	15			170	100		120	200	20	280	100	1,505	19
Thailand								500			200		700	2
Indonesia							100						100	1
Kosrae												50	50	1
Okinawa										36			36	1
TOTAL	6,665	2,624	5,885	5,666	14,320	2,468	12,630	2,875	5,383	10,040	12,525	9,475	90,556	314

Table 6. Numbers of frozen bats imported to Guam from October 1, 1985 to September 30, 1986.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	No. of Shipments Received	No. of Bats Confiscated	No. of Shipments Confiscated
Western Samoa	747	500	450	690	590	195	400		150	1,184	1,359	770	7,035	21	0	0
Philippines				335	250	900			103	860		23	2,471	11	23	1
Palau	166	150	409	160	195	310	186	113	375	183	131	24	2,402	63	127	10
Truk	23	100	50	4		20			100	42	200	200	739	9	62	2
American Samoa	450	65									10		525	5	0	0
Pohnpei	90	29		50	20		15						204	6	20	1
Saipan	5	22				3		2	16	5		1	54	12	32	7
Rota	5						1					1	7	3	7	3
Indonesia							7						7	1	0	0
Unknown origin		3			1								4	3	4	3
TOTAL	1,486	869	909	1,239	1,056	1,428	609	115	744	2,274	1,700	1,019	13,448	134	275	27

supplier of bats during each of the last four years, averaging 7,300 bats per year. Islands within Micronesia shipped 3,406 fruit bats to Guam (25% of the total), with most of these (2,402 animals) originating in Palau. The Philippines became a important exporter of fruit bats for the first time during FY 1986. The country sent 2,471 bats to Guam.

One retailer imported 8,838 bats or 66% of all animals brought to Guam during the year. All of his shipments originated in Western Samoa or the Philippines.

During FY 1986, 275 fruit bats in 27 shipments were confiscated by the Guam Customs and Quarantine Division upon entry into Guam. Shipments were seized for a number of violations including lack of import permits, lack of certificates of origin, or because the bats originated from islands where they were protected by local laws. Sixty-one bats entered Guam from Saipan and Rota in FY 1986. Only 39 of these animals were seized by customs authorities although all were in violation of CNMI and Guam wildlife regulations.

In August, a report was obtained from reliable sources in the CNMI that unknown numbers of fruit bats continue to be smuggled into Guam from Rota. Bats are reportedly packed in coolers filled with fish and brought to Guam by small boats or commercial airlines. A similar report was obtained in FY 1985 (DAWR 1985).

Public Education

Dr. Merlin D. Tuttle of Bat Conservation International visited Guam from 3-12 January 1986 and was successful in photographing Marianas fruit bats in captivity and in the wild. These photographs and information obtained during his visit will be used for educational purposes in the Pacific region and the U.S. Tuttle hopes to prepare a slide show that will discuss the ecology of *Pteropus* and their exploitation by humans and will be distributed widely among the Pacific islands.

RECOMMENDATIONS

1. Survey bat numbers and distribution along Guam's entire northern cliffline once or twice annually. Searches for additional colonies may prove to be productive because continued poaching at bat roosts on Rota (Wiles, pers. observ.) could cause large numbers of bats to move to Guam.

2. Continue to make observations at Guam's bat colonies. Information should be gathered on reproductive biology, behavior within the colonies, and the sex and number of bats present.

3. Known bat roosting and foraging areas should be patrolled regularly by Conservation Officers. Part of their effort should be aimed at maintaining a visible presence at Jinapsan and Pajon Points, where poaching has been a serious problem in previous years.

4. Determine the amount of predation on fruit bats by brown tree snakes. The age classes of bats that are most susceptible to predation by snakes must be investigated. The extent of predation occurring at colonies and during foraging at night should be determined.

5. Form a cooperative bat research program with the CNMI to collect information on the locations and sizes of colonies, reproductive biology and behavior within colonies. Most of the work done under this program would be conducted on Rota where a relatively large bat population is found but where logistics prevent the CNMI from

doing extensive field work. Emphasis of this project would be to identify colonies should they move between Guam and Rota.

6. Continue to monitor fruit bat imports entering Guam. Export permits or certificates of origin should continue to be required for all shipments to ensure that the bats have been legally harvested, that the place of origin is known, and that the government authorities at the place of origin are aware of the drain on their fruit bat populations.

LITERATURE CITED

Division of Aquatic and Wildlife Resources. 1964-1985. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration, Guam. Department of Agriculture, Government of Guam, Agana, Guam.

Lemke, T.O. 1984. Marianas fruit bat surveys and inventories. Pages 3-16 in Pittman-Robertson Federal Aid in Wildlife Restoration Program, Annual Report, FY 1984. CNMI Div. Fish Wildl., Saipan. 137 p.

Perez, G.S.A. Observations on Guam bats. Micronesica 8:141-149.

Wheeler, M.E. 1979. The Marianas fruit bat: management history, current status and future plans. Calif. - Nev. Wildl. Trans. 10:149-165.

Wheeler, M.E. 1980. The status of the Marians fruit bat on Saipan, Tinian, and Rota. 'Elepaio 40:109-113.

Wheeler, M.E. and C.F. Aguon. 1978. The current status and distribution of the Marianas fruit bat on Guam. Aquatic and Wildlife Resources Division, Tech. Rep. No. 1, 29 pp.

Wiles, G.J. in prep. Status of fruit bats on Guam.

Report prepared by: Gary J. Wiles

GUAM ENDANGERED SPECIES INVESTIGATIONS
PROJECT E-1-1
Section 6 - Endangered Species Act of 1973

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-1
STUDY NO.: 1
JOB NO.: 2

JOB TITLE: Impact of *Boiga irregularis* and Other Predators on Native Bird Populations.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Studies on the impact of the brown tree snake, *Boiga irregularis*, on Guam's avifauna and on the ecology and biology of this snake are in progress.

BACKGROUND

Guam's native birds have declined drastically in recent decades while avian populations have remained relatively stable on other nearby islands. Research indicates *B. irregularis* is responsible for the range reductions and extinctions of the forest avifauna.

OBJECTIVE

To determine the impact of predation by *B. irregularis* and other predators on bird populations and to study the ecology and biology of this snake.

PROCEDURES

1. Procedures used for determining the impact of *Boiga irregularis* on the native birds are detailed in Savidge (1986a).

2. Transects with bird-baited funnel traps were employed to determine predation pressure in various locations on Guam.

3. Nests of the Philippine Turtle-Dove were monitored by P. Conry, DAWR biologist, to determine nesting success and causes of nest failure.

4. Distribution and abundance of alternative prey items for the snake, particularly small mammals, were investigated.

5. Snakes have been collected on a regular basis to track changes in diet as prey populations decline, to document what prey the various size classes take, to gain information on the age structure of the snake population, and to study the reproductive biology of the species.

RESULTS

Research results concerning the impact of *B. irregularis* on Guam's native forest avifauna will be published in the journal Ecology.

The NCS area was retrapped in May with bird-baited traps to compare with results obtained in the previous year. Predation was still very high with 100 percent of the traps being hit by snakes within 13 nights. In 1984, 100 percent predation occurred within 11 nights (Savidge 1986a).

Studies on the nesting success of the introduced Philippine Turtle-Doves (*Streptopelia bitorquata*) indicate continued low nesting success largely due to predation by snakes (Conry 1986). See FW-2R-23, Sub-Project W-2, Study 1, Job 2, for additional details.

A paper on the impact of *Boiga* on small mammal populations is in preparation (Savidge 1986b). Additional trapping for small mammals confirmed that their densities are still very low on Guam and that these species have probably also been severely impacted by the brown tree snake. *R. exulans* was found on Cocos Island. This is the only location that this species has been caught at although it was previously common on Guam.

Snakes are being collected on a monthly basis to obtain information on diet, reproduction, and population characteristics. A paper has been written on the food habits of *Boiga* and is currently under journal review (Savidge 1986c). Analyses of 683 snake stomachs showed that *Boiga* is generalized in diet and consumes birds and their eggs, small mammals, and lizards and lizard eggs. Ontogenetic differences in diet were present. Small snakes eat primarily lizards, and large snakes consume birds, bird eggs and small mammals. All three prey types are consumed by medium-sized snakes. The size structure of the snake population reflects the available prey base. There are few birds and small mammals left in forest and second-growth habitat, and consequently, there are also few large snakes in these habitats. Reproductive data is still being analyzed, but it appears that the snakes reproduce year-round though there may be a breeding peak during the wet season.

RECOMMENDATIONS

1. Publish existing data on the impact of *Boiga* on its mammalian prey and on *Boiga's* reproductive biology.

2. Continue to investigate the natural history, abundance and distribution of *Boiga.*

3. Encourage continued Federal involvement in developing control methods for *Boiga.*

LITERATURE CITED

Conry, P. 1986. High nest predation by brown tree snakes on Guam. In review.

Savidge, J. A. 1986a. Extinction of an island forest avifauna by an introduced snake. Ecology, in press.

Savidge, J. A. 1986b. The impact of the introduced snake, *Boiga irregularis*, on the small mammals of Guam. In preparation.

Savidge, J. A. 1986c. Food habits of *Boiga irregularis*, an introduced predator on Guam. In review.

Report prepared by: Julie A. Savidge

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-1
STUDY NO.: 1
JOB NO.: 6

JOB TITLE: Impact of Avian Disease on Guam's Native Bird Populations.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

A study of the impact of avian disease on Guam's bird populations was conducted from 1982 through 1985. Analyses of samples obtained during the August-September 1984 sentinel study were completed by the U.S. Fish and Wildlife National Wildlife Health Lab. There is no evidence that disease was responsible for the extirpation of the native forest birds.

BACKGROUND

Guam's native birds have declined drastically in recent decades. Because of a similar decline (in terms of degree of severity) in native Hawaiian birds in which disease was implicated (Warner 1968, van Riper et al. 1982), introduced diseases were suggested as a possible cause of Guam's bird decline.

Between 1982-1985, a variety of birds on Guam were surveyed for diseases and a sentinel study exposing birds to potential disease vectors in the forests of northern Guam was conducted in collaboration with the U.S. Fish and Wildlife National Wildlife Health Lab (NWHL).

OBJECTIVE

To determine the presence and impact of avian disease on Guam's bird populations.

PROCEDURES

1. Bacterial, viral, tissue, and serum samples obtained during the disease studies were sent to the NWHL for diagnostic examination. Both NWHL and DAWR analyzed blood slides.

RESULTS

No evidence of consistent disease was found in samples from 134 carcasses and 246 live birds examined between 1982-5 on Guam.

Analyses of samples obtained during the August-September 1984 sentinel study were recently completed by Dr. L. Sileo of the National Wildlife Health Laboratory. Results of

the sentinel suggested disease was not involved in the avian declines. General comments regarding cause of death for birds that died in the sentinel are as follows: 1. Canaries: there was no consistent cause of death. Several died from apparent acute effects of the drug used as a immunosuppressant. In general, no remarkable bacteria were isolated; 2. White-eyes: most birds succumbed to apparent effects of the immunosuppressant drug. Salmonella was isolated from one bird; 3. Coturnix Quail: only one quail died and cause of death was mycotic pneumonia; 4. Chickens: cannibalism was the cause of death of each of the five chickens that died during the study.

Avian pox occurred in 7 of the 13 chickens at one sentinel site. However, the pox was relatively avirulent and did not grow well in the laboratory isolation systems.

RECOMMENDATIONS

1. DAWR, in cooperation with NWHL, should submit a final report.

2. Vanikoro Swiftlets should be sampled for diseases. This species, a cave nester, declined in a dissimilar pattern to the forest birds.

LITERATURE CITED

Warner, R. E. 1968. The role of introduced disease in the extinction of the endemic Hawaiian avifauna. Condor 70(2):101-120.

van Riper, C., lll, S. G. van Riper, M. L. Goff, and M. Laird. 1982. The impact of malaria on birds in Hawaii Volcanoes National Park. University of Hawaii Coop. Natl. Park Resources Studies Unit Tech. Rep. No. 47, Honolulu.

Report prepared by: Julie A. Savidge

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT N0.: E-1-1
STUDY NO.: 4
JOB NO.: 1

JOB TITLE: Captive Breeding Endangered Native Birds.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Eight Micronesian Kingfishers were captured and transported to the Philadelphia Zoological Gardens for purposes of captive breeding. Thirteen Guam Rails were transported to the National Zoological Park for purposes of captive breeding. Five captive bred Guam Rails were transported from mainland Zoos to Guam. Seven Guam Rails were bred at the Guam Aquatic & Wildlife Resources facility. The first Guam Rails to be seen in the wild since July 1985 were observed on AAFB and one was captured on September 19, 1986. By September 30, 1986 there were more than 85 rails and 36 kingfishers in captivity on Guam and at stateside zoos.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam Rail, *Rallus owstoni,* and other native birds (DAWR 1961-1985); Jenkins 1979, 1983; Engbring 1984). Most native forest birds are now either extirpated from the wild or restricted primarily to Northwest Field and Conventional Weapons Storage Area and surrounding cliffline areas on Andersen Air Force Base (AAFB) in Northern Guam. By 1985, the known Guam Rail population numbered less than 5 and was restricted to the flightline area on AAFB.

Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Conry 1986, Savidge 1986a, 1986b).

A captive breeding program aimed at preserving in captivity Guam's endemic species and subspecies of native forest birds was begun in late 1983 in cooperation with the American Association of Zoological Parks and Aquariums and several of it's member zoos (DAWR 11983). Efforts at captive breeding the Bridled White-eye, Rufous Fantail and the Guam Flycatcher were abandoned in 1984 due to their disappearance in the wild (DAWR 1984). In January 1984, six pairs of Micronesian Kingfishers were transported to the Philadelphia Zoo after being captured on Guam in the fall of 1983. Some were distributed to the Bronx Zoo in New York City and the Conservation and Research Center (CRC) of the National Zoological Park, Front Royal, Virginia. By September 1984, none had bred in captivity. Guam Rails were first brought into captivity in 1983 on Guam and bred at the DAWR's rail

captured on Guam and transported to the Philadelphia Zoo in November 1984. During the summer of 1985, the first kingfishers were hatched in captivity at three mainland zoos. In July, 1985, efforts to capture additional rails were suspended because no rails could be found in the wild to capture. By September 30,1985, there were 26 kingfishers in captivity at mainland zoos and 56 rails in captivity both on Guam and at mainland zoos (DAWR 1985).

OBJECTIVES

Implement a captive breeding program for the Guam Rail and other endangered endemic birds by setting up facilities on Guam and at zoos on the mainland with the assistance of the American Association of Zoological Parks and Aquariums. Develop techniques for release of captive reared birds in the wild once the factors responsible for their decline have been identified and controlled.

PROCEDURES

1. Continue to consult with recognized authorities regarding captive breeding methodology, facility designs, and captive population management techniques.

2. Continue the development of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and it's member zoos.

3. Begin development of capture and captive breeding techniques for the Mariana Crow.

4. Develop techniques for the successful release of captive-reared birds in the wild once the factors responsible for their decline have been controlled.

5. Upgrade and enlarge the Guam Rail breeding facility at DAWR office in Mangilao to allow up to 50 birds to be held in captivity.

6. Develop techniques for successful release of captive reared birds into the wild.

7. Continue to develop techniques for successful release of captive reared birds into the wild.

8. Conduct study into the breeding biology in the field on Guam of birds that are to be captive bred.

9. Consult and coordinate with U.S. Fish and Wildlife Service, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits.

RESULTS

From 22 September to 24 November 1985, a study of the breeding biology of the Mariana Crow on Guam was conducted by Gary Michael, Asst. Curator of Birds of the Philadelphia Zoological Garden in cooperation with the DAWR staff (Michael 1986). Several crow nests were located but no successful breeding was observed, apparently due to predation by the brown tree snake, *Boiga irregularis*, in spite of efforts of the DAWR staff to snake proof the sites. Nest site observations and efforts at snake proofing continued after Michaels departure.

From October 1985 until January 1986 eight Micronesian Kingfishers, *Halcyon c. cinnamomina,* were captured on AAFB. One died in captivity on November 3, 1985. The findings of a necropsy were inconclusive but suggested stress from capture. On January 29, 1986, eight Micronesian Kingfishers (including one caught during the summer of 1985) were transported to the Philadelphia Zoo from where they were to be transhipped to several zoos for captive breeding. As of September 1986, there were 36 kingfishers breeding in captivity at eight stateside zoos (S. Derrickson, per. comm., Conservation and Research Center, Smithsonian Institution, Front Royal, Va.).

Captive breeding of the Guam Rail continued at the DAWR's facility with 7 chicks hatching. Two rails died, one from sibling aggression and the other from unknown causes. In January 29, 1986, 13 rails were transported to the National Zoological Park, Smithsonian Institution, Washington, D.C. for distribution to several cooperating zoos for captive breeding. At the DAWR facility, mated pairs of rails were separated in late March to prevent further breeding pending construction of additional aviaries. As of September 30, 1986, there were 18 rails in captivity on Guam and more than 67 at stateside zoos (S. Derrickson, per. comm.).

An immature rail was captured accidentally from the wild on September 19, 1986 on AAFB by Air Force personnel. It is now at the DAWR facility. A survey of the area where it was found revealed at least one more rail. There did not appear, however, to be a population in the area. These are the first rails sighted in the wild since July 1985 (DAWR 1985).

RECOMMENDATIONS

1. Continue to consult with recognized authorities regarding captive breeding methodology, facility design, and captive population management techniques.

2. Continue development of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and it's member zoos.

3. Continue efforts to develop techniques in the field for snake-proofing nest sites of the Marianas Crow.

4. Continue observations of the breeding biology of the Mariana Crow on Guam.

5. Upgrade and enlarge the Guam Rail breeding facility at DAWR office in Mangilao to allow up to 50 birds to be held in captivity.

6. Seek funding for transport of birds to zoos for captive breeding from conservation groups and other private sources.

7. Develop techniques for release of captive reared birds into the wild.

8. Implement plan to translocate captive bred Guam Rails to Rota in order to establish a wild population.

LITERATURE CITED

Guam Aquatic & Wildlife Resources Division, 1961-1985. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration.

Conry, P. J. 1986, In prep. High nest predation by the brown tree snake on Guam. Aquatic and Wildlife Resources, Dept. of Agriculture, Govt. of Guam, Agana, Guam.

Engbring, John and F. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: Results of a 1981 survey. U.S. Fish and Wildlife Service. FWS/OBS-84/20.

Jenkins, J.M. 1979. Natural history of the Guam Rail. Condor 81: 404-498

Jenkins, J.M. 1983. The native forest birds of Guam, Ornithological Monograph #31, American Ornithologists Union.

Michael, G. 1986. A field study of the Mariana Crow. in Guam Bird Rescue Project. Larry Shelton ed., The Philadelphia Zoo Review 2(2):11-18, Philadelphia Zoological Garden, Philadelphia, Pa.

Savidge, J. A. 1986a. The role of disease and predation in the decline of Guam's avifauna. Ph.D. Thesis. University of Illinois, Urbana-Champaign.

Savidge, J. A. 1986b, in press. Extinction of an island avifauna by an introduced snake. Ecology.

Report prepared by: Robert E. Beck, Jr.

GUAM ENDANGERED SPECIES INVESTIGATIONS
Project E-1-1-2
Section 6 - Endangered Species Act of 1973

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT N0.: E-1-2
STUDY NO.: 4
JOB NO.: 1

JOB TITLE: Captive Breeding Endangered Native Birds.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Activities under this job are reported under Project E-1-1, Study 1, Job 4, which ran concurrently.

Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT N0.: E-1-2
STUDY NO.: 5
JOB NO.: 1

JOB TITLE: Status Surveys and Natural History of Endangered Native Birds.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Activities under this job were consolidated with Project FW-2R-23, Sub-Project W-4, Study 1, Job 3, and results are reported under that job.

Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT N0.: E-1-2
STUDY NO.: 6
JOB NO.: 1

JOB TITLE: Law Enforcement and Legal Protection for the Marianas Fruit Bat.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

This job was relatively inactive during this segment. Activity mainly consisted of monitoring fruit baat imports, documenting fruit bat seizures, and investigating incidents of colony disturbance for signs of illegal hunting activity. Results of this activity was consolidated with other fruit bat research and reported under Project FW-2R-23, Sub-Project W-5, Study 1, Job 2, which ran concurrently.

Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT N0.: E-1-2
STUDY NO.: 6
JOB NO.: 2

JOB TITLE: Natural History, Biology, and Habitat Protection for the Marianas Fruit Bat.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Activities under this job are reported under Projecat FW-2R-23, Sub-Project W-5, Study 1, Job 2, which ran concurrently.

Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 7
JOB NO.: 1

JOB TITLE: Biology of the Brown Tree Snake.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

Activities under this job are reported under Project E-1-1, Study 1, Job 2, which ran concurrently.

Report prepared by: Julie A. Savidge

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 7
JOB NO.: 2

JOB TITLE: Movements, Home Ranges and Activity Patterns of Brown Tree Snakes.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

One female brown tree snake (*Boiga irregularis*) was instrumented with a radio transmitter and tracked for 22 days in northern Guam in 1986. Daily movements averaged 24.1 m per day and 82% of all radio fixes occurred in the upper canopy of the forest. Additional data on habitat and weather characteristics were gathered.

BACKGROUND

Predation by brown tree snakes is a primary cause for the range reductions and extinctions of 10 species of native forest birds on Guam (Savidge 1986). Snakes are also thought to be a major predator on the island's population of Marianas fruit bats (*Pteropus mariannus*) (Wiles in prep.). Recovery efforts for endangered birds and bats on Guam should concentrate on controlling and perhaps eventually eradicating the brown tree snake from the island. Information on the ecology and biology of *B. irregularis* will be useful in designing and implementing a control program for these animals. The use of radio telemetry will assist researchers in learning more about the species' movements, activity patterns and habitat use.

OBJECTIVES

To study the movements and activity patterns of the brown tree snake in order to gain the knowledge and understanding necessary to evaluate predation impacts and to develop effective control methods as recommended in the Native Forest Bird and Fruit Bat Recovery Plans.

PROCEDURES

1. Medium to large-sized snakes were captured at night by hand and brought to the Guam Division of Aquatic and Wildlife Resources.

2. Snakes were immobilized with ketamine hydrochloride and radio transmitters were implanted into the posterior portion of their abdomens (Wiles 1985).

3. After a one to two-day recovery period, instrumented snakes were released back into the wild at their point of capture. Animals were relocated on an almost daily basis using a hand-held antenna to track transmitter signals.

4. A number of information parameters were recorded at each daytime resting site where a snake was relocated. These included data on behavior distances moved, habitat characteristics, and weather.

RESULTS

A single female snake weighing 145 gr and measuring 1.39 m in total length was captured during FY 1986 and implanted with a radio transmitter. This individual was more comparable in size to the animals normally found in Guam's population of brown tree snakes (Fritts and Scott 1985) than were four larger snakes studied previously in FY 1985, which averaged 1.61 kg in weight and 2.29 m in total length (Wiles 1985). The snake tracked this year was caught at a site in the Conventional Weapons Storage Area (CWA) on Andersen Air Force Base and released later at the same location. In contrast, the animals studied in FY 1985 had been translocated from central Guam to study sites at Tarague Beach and Northwest Field. Thus, the movements and habitat use data obtained in FY 1986 are believed to be more representative of the entire snake population than those gathered in FY 1985.

The snake studied in FY 1986 was captured in secondary forest inside the CWA. It was located 17 times during a 22-day period in May and June. The snake was apparently inactive during each radio location, all of which were obtained during daylight. In all but three radio fixes, the animal was found in the upper portions of the forest canopy, usually within 0.5-2 m of the top of a tree at heights ranging from 3.3-9.1 m above the ground. The average distance moved per day during a 10 consecutive day tracking period was 24.1 m with movements occurring on 8 days during this time. During the entire study period, the snake confined its movements to a roughly oval-shaped area that was approximately 40 m X 100 m in size. Nine (53%) of the 17 resting sites used by the animal occurred in forest within 10 m of the edge of a roadside. This indicates that the snake may have been reluctant to cross the mowed roadside and dirt road, preferring to travel along the edge of the forest.

RECOMMENDATIONS

1. Conduct this study on a full-time basis in FY 1987 and monitor the movements of at least 8 individual snakes.

2. Increase the amount of night-time tracking to learn more about snake behavior at night. Conduct 24-hour tracking sessions to obtain more accurate information on daily movements.

3. Continue to conduct the study in the CWA of AAFB. This area of secondary limestone forest is representative of large areas of forest in much of northern Guam. The area appears to contain a high density of snakes.

LITERATURE CITED

Fritts, T.H. and N.J. Scott, Jr. 1985. The brown tree snake on Guam: studies of its ecology, control, and threats to other islands. U.S. Fish and Wildlife Service, Portland. Unpublished. 85 pp.

Savidge, J.A. 1986. The role of disease and predation in the decline of Guam's avifauna. Ph.D. thesis. Univ. Illinois, Urbana-Champaign.

Wiles, G.J. 1985. Preliminary results of a radio-tracking study of brown tree snakes on Guam. Guam Div. Aquatic Wildl. Resources Ann. Rept., FY 1985. Dept. Agriculture, Mangilao.

Wiles, G.J. in prep. The status of fruit bats on Guam.

Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 7
JOB NO.: 3

JOB TITLE: Development and Testing of Control Methods for the Brown Tree Snake.

PERIOD COVERED: October 1, 1985 to September 30, 1986.

SUMMARY

No significant effort was expended on this job during this segment.

Report prepared by: Robert D. Anderson

LAW ENFORCEMENT
Funding Source: Government of Guam

LAW ENFORCEMENT

For Fiscal Year 1986, Conservation Officers have arrested and charged thirteen persons for the offense of illegal hunting and illegal fishing. Eight of these individuals were apprehended by Military Personnel (Security). Among these group, five were intercepted for illegally hunting and three for illegal possession of under-sized spiny lobsters and spiny lobsters with eggs inside military jurisdiction. Upon investigation and receiving custody of these subjects they were officially charged for violating fish and game laws.

Four other individuals who were referred to the Conservation Offices were also charged for illegal possession of a deer carcass after they were intercepted by Guam Police Officers for a speeding violation. As a result of this incident, a 4x4 Toyota pickup truck was also confiscated as part of the evidence. This truck was later forfeited to the Government of Guam because it had been used to transport illegally taken game in violation of the fish and game laws of Guam.

Another individual among the arrestees was apprehended by Conservation Officers during the early morning hours while they were routinely doing roadside bird counts. He was found in possession with four military duffel bags filled with field dressed deer carcasses.

A total of four individuals have already pleaded guilty and the rest are awaiting prosecution by the Attorney General.

Out of the twelve cases from FY 85, eleven individuals have either been found guilty or have pleaded guilty. A 4x4 Toyota pickup truck which had been seized as evidence in an alleged poaching violation was relinquished to the bank on account of repossession. A Chevrolet pickup truck with camper that was impounded in a carabao poaching case at Naval Magazine, was released to our custody for safekeeping. The court hearing on a forfeiture action against this vehicle is still pending.

Although the Law Enforcement section has operated at a reduced manpower level throughout this fiscal year, numerous reports of illegal hunting and fishing were investigated. Upon receiving these report by concerned citizens, Conservation Officers were dispatched to investigate. Among incidents that were recorded were illegal hunting; gunshots; dynamiting; fish poisoning; turtle hunting; abandoned gill nets; selling imported live crabs; selling under-sized lobsters; selling local deer meat; selling local fruit bats and illegal harboring of wild game.